The FOUNDRY

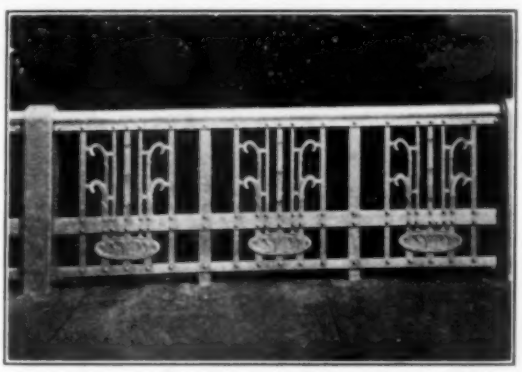
Volume 58
Number 6

Published
Semimonthly

CLEVELAND, OHIO, MARCH 15, 1930

Castings Stop a Skidding Car Headed for the River

FOR some unknown reason, an exceptionally large number of automobiles seem to take particular delight in doing a few side slips, a nose dive or two and a wee bit of skidding while passing over bridges. These antics may be attributed to the contrariness of the flivver and her more aristocratic sisters, or to a feeling of dizziness



Courtesy Fort Pitt Malleable Iron Co.

Beauty and Strength Have Been Combined in this Bridge Railing Through the Use of Malleable Castings

which overcome drivers when traveling at such extreme heights. Nevertheless, it presents a problem in providing a railing which will withstand the assults of the temperamental auto. Various engineering materials have been used for this purpose and recently a bridge was built with railings constructed of malleable castings. This structure, known as the Liberty bridge, spans the Monongahela river at Pittsburgh and has a length of 2663 feet exclusive of the approaches. Specifications for the malleable castings called for a tensile strength of 50,000 pounds per square inch and an elongation of 10 per cent in 2 inches. The castings were tested in almost every conceivable manner and the results were far above expectations. A tensile strength of approximately 59,000 pounds per square inch, an elongation of about 25.5 per cent in 2 inches and a tremendous resistance to impact were secured. In addition, the casting process permitted an exceptionally artistic conception.

Find Where Castings Can Be Sold.

CONTENTS

FEATURE ARTICLES

	Page
Imagination Builds Business in Cast Iron Toys—By Pat Dwyer	74
Should Schools Teach Engineers Foundry Practice?	80
Sand Control Increases Economy in the Foundry—Part I—By O. E. J. Abrahamson	84
American Brass Foundry Practice—Part VI—By Charles Vickers	88
Modern Foundry Flourishes in the Orient—By P. D. Forbes	91
Fundamentals of Foundry Practice—Part VI—By Ivan Lamoureux	93
Bill Reads a Story About a Foundry—By Pat Dwyer	102
Cleveland Prepares for Visiting Foundrymen	107
Steel Founders Discuss Merchandising	108
Cupola Malleable Is Cast in Permanent Molds—Part II—By Harvey W. Hyde	109

REGULAR DEPARTMENTS

Questions and Answers on Foundry Practice	98	**Comings and Goings of Foundrymen**	115
Problems in Nonferrous Founding — By Charles Vickers	101	**Trade Trends in Tabloid**	119
What Others Are Thinking	113	**What the Foundries Are Doing**	120
The Shakeout	114	**New Trade Publications**	120

—⊡—

PUBLISHED BY THE PENTON PUBLISHING CO., CLEVELAND, O.
BRANCH OFFICES

CHICAGO.....1347 Peoples Gas Bldg.
CINCINNATI.....209 Edwards Bldg.
NEW YORK.....2203-2206 No. 220 Broadway
PITTSBURGH.....2148-49 Oliver Bldg.
SAN FRANCISCO.....24 California Street
WASHINGTON, D. C.....1653 Pennsylvania Avenue
LONDON, ENGLAND.....416-417 Caxton House, Westminster, S. W. 1
BIRMINGHAM, ENGLAND.....14 New Street
PARIS, FRANCE.....No. 9 Rue de Londres
BERLIN, GERMANY.....Dahlmerstrasse 64A, Berlin Lichterfeld-West

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....£1:0:0 a year
Single Copies.....25 cents

Copies published three months or more previous to date of current issue, 50 cents each.

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers' Association

The A. B. P. is a nonprofit organization whose members have pledged themselves to a working code of practice in which the interests of the men of American industry, trade and professions are placed first—a code demanding unbiased editorial pages, classified and verified subscribers, and honest advertising of dependable products

Copyright 1930 by the Penton Publishing Co.

Imagination in CAST

THE average man, a convenient term for the individual who bulks fairly large in the vital statistics of any given cross section of the population, never fails to get what he naively describes as a kick out of one and sometimes both of two things. One is the activities of many men of high repute in the scientific circles of the world who spend time of priceless value dropping buckets into empty wells of investigation and drawing nothing up. The other kicky item is the spectacle of eminent savants advancing special theories or facts as their own particular discovery, when said theories or facts have been accepted as common knowledge since about the time man descended from the trees and learned to walk upright on a single pair of feet.

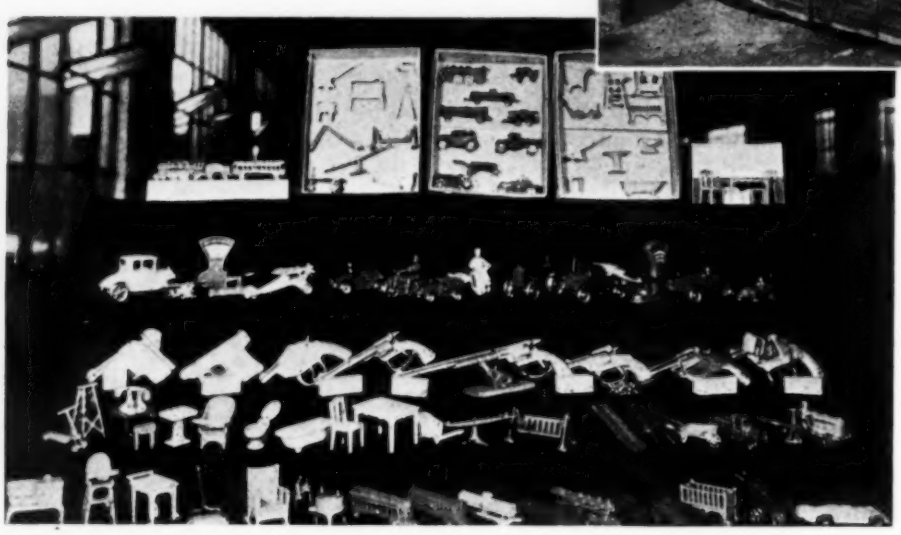


Fig. 1—Toy Pistols And a Variety of Other Toys

Fig. 2—General View of

One of these investigators, an authority in the field of juvenile education, recently dropped his bucket into a well of investigation and brought up the startling information that play is as necessary as food or education to the proper development of a child. Also he discovered—and this second discovery is more remarkable than the first—that to play properly, children must have toys.

With the possible exception of Adam and Eve, a lady and gentleman unfortunately deprived of the blessed joys and privileges of childhood, practically every generation from their day to ours have played with toys of one kind or another. In fact if a person were minded to split hairs over the subject, he might claim with a certain amount of justification that the incident of the apple seems to indicate that even Adam and Eve had their playful moments. Archeologists grubbing in the ruins of Tyre and Sidon, rooting under the accumulated dust, debris and sand blown through unnumbered centuries by the winds of the desert over the ancient city of Babylon, have discovered dolls that once were more precious than gold and rubies in the adoring eyes of little innocent maidens who knew little and cared less of or for the theories and purpose of education. The crude little dollies filled their hearts with delight. They played with them by day and they slept with them by night. Their cup of happiness was filled to the brim so long as the objects of their affection retained their perfection. They grieved—as modern little ones grieve—when cruel fate knocked out an eye, or lopped off an arm or a leg.

Playing with toys is not exactly a modern institution.

Statistics on methods of manufacture and distribution are rather vague and sketchy prior to the advent of the jolly old whiskered gentleman

Interior of the Foundry

Builds Business

Iron Toys

By

PAT DWYER

season. At one time Santa Claus depended on two main sources of supply. One was his famous emporium somewhere—not to be too inquisitive—in the general vicinity of the North pole. The other was Europe. Climatic conditions, the advent of the air ship and growing skepticism on the part of innocent little tots have cut into the North pole prestige and tradition to an alarming extent. The recent war in Europe practically cut off the supply from over seas. In the face of such depressing circumstances, an ordinary person would have abandoned the children to their toyless fate. Needless to say, Santa Claus is not an ordinary

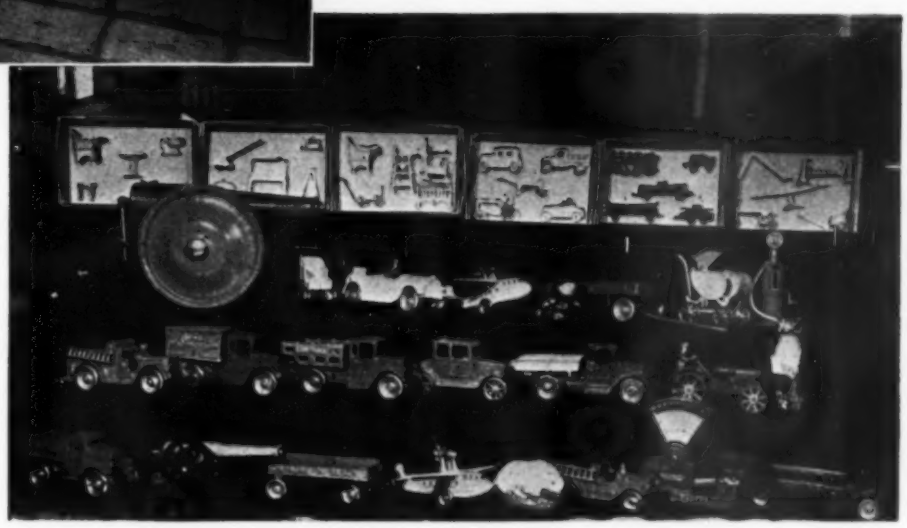


Fig. 3—Typical Assortment of Cast Iron Toys

with the pack and the reindeer. The saint whose ermine trimmed clothing always appears to be strained to the elastic limit. With the coming of this enterprising, mercantile genius, the business gradually began to assume a place among the major industries. It attracted the attention of chambers of commerce and of the people who impose export and import duties.

At first, Santa confined his activities to the Christmas season, but the increasing weight of the pack from year to year, induced him to extend the period of his operations. A line drawn upon the present chart of toy distribution remains fairly straight for the greater part of the year with an exceptionally high peak at Christmas and with somewhat lesser peaks at Thanksgiving and at Easter.

Elevation of the peak at Easter is due in part to the well known proclivities of the rabbit to lay millions of multicolored eggs at this festive person. He rose to the occasion gallantly and sent out the clarion call for help. No less gallantly, the toy makers of America answered the call. Today, with the exception of a few, small scattered lines, all the toys consumed—and consumed is right—in the United States are manufactured inside its own borders. Also, the volume of business steadily is increasing.

One of the prominent manufacturers of cast iron toys is the Andes Foundry Co., Lancaster, Pa. The scope of its activities extends from the creation of the design to the final shipment of the finished goods. That includes the drawings, models, master patterns, matchplates, molding, pouring, melting, cleaning, polishing, nickel plating, painting, assembling, packing and shipping.

E. B. Andes, president of the company, practical molder, pattern maker, inventor and mechani-

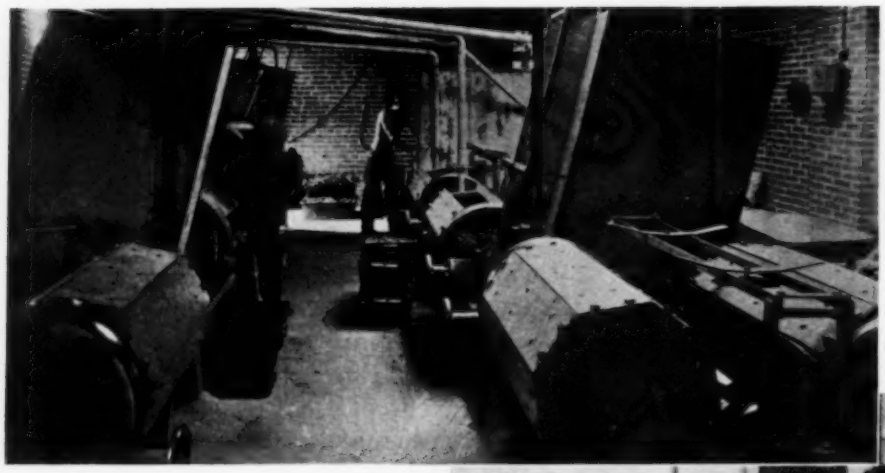


Fig. 4 (Above)—Tumbling Barrels Are Equipped with Friction Drives and Are Connected to a Dust Exhaust System

cal genius, conducted a patternshop of his own for several years where he devoted special attention to the design and fabrication of matchplates and other pattern equipment for foundries. Between times he developed a toy pistol and magazine cap ammunition. Demand for this highly meritorious weapon led Mr. Andes to devote most of his time to its manufacture.

Eventually he erected a small plant and gradually added other lines of cast iron toys. Several years ago the present large, modern plant was erected including a brick, steel and glass foundry, 50 x 200 feet. The toy pistol still is the largest item manufactured with a daily output of 85 gross. Castings of this kind are not counted singly or even in dozens. They are reckoned by the gross, a quaint old English term still surviving for 12 dozens. On an individual count of 12,240 the total seems even more impressive. Other items in large variety are shown in Figs. 1 and 3.

With the exception of the pistol which seems to have a perennial appeal, constant changes take place in the character of the other toys manufactured. For that reason, new designs constantly are in process of creation. When demand for one line falls off, a new line is started and continued so long as it remains profitable. Greatest demand naturally comes from the large cities and from thickly populated districts in the eastern and middle western states. The saturation point in the toy industry apparently is farther in the future than the hypothetical automobile saturation point. For example a recent survey disclosed that the distribution of toys in Wisconsin amounted to only 2 per juvenile capita. Many states evidently still are virgin territory for the absorption of the output of the toy shops.

Fig. 5 (Below)—Cleaned Castings Are Sorted on a Long Bench and Separated from the Stars and Defective Castings

A considerable amount of planning and hard work is required to place a new line of cast iron toys on the mar-

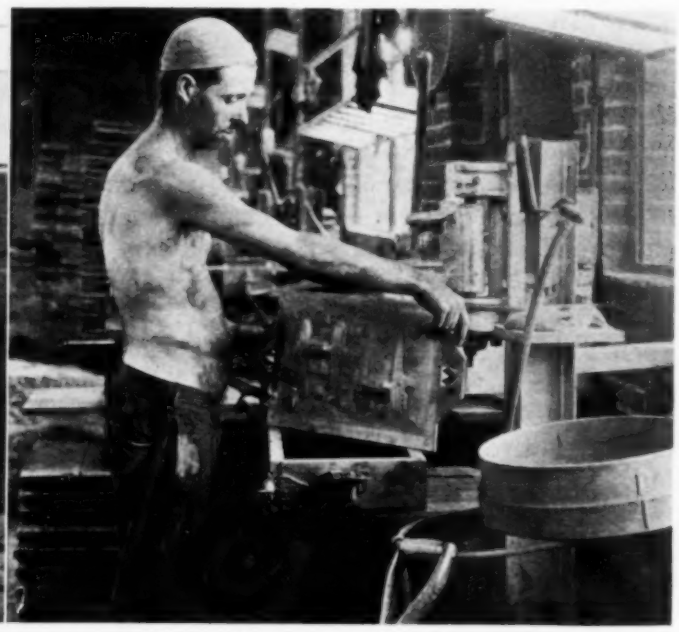


Fig. 6—Molding Stations Are Well Lighted and Ventilated. Fig. 7—Knobs on the Face of the Pattern Plate Insure an Accurate Fit Between Cope and Drag

ket. No standard recipe ever has been discovered by which the manufacturer can tell in advance whether the line will be a success or a failure. Out of the depths of his artistic nature, knowledge of manufacturing facilities, limiting factors of various kinds and general knowledge based on many years experience, the designer produces a new toy and places samples in the hands of the wholesale distributors. If it looks good to them he receives a pleasing volume of orders. If the toy does not meet with their fancy, the models and patterns are scrapped and the effort is charged to operating expense.

Fig. 8 (Below)—Enameled Castings Are Removed from the Conveyor in the Assembly Room

Fig. 9 (Above)—Castings Are Attached to Rods Preparatory to Going on the Conveyor

Every year in February the toy makers of the country congregate in New York to display the goods for the coming year. Wholesale distributors, agents of various kinds and buyers from all the big stores between New York and San Francisco, attend this show and either contract for a year's supply, or indicate fairly definitely the lines that will be in further demand until the next buyers meeting.

A special effort is put forth by all toy manufacturers to show new models at this great Spring exhibition.

At the plant of the Andes Foundry Co., the new shapes first materialize in the imagination of W. B. Andes, superintendent of the plant and son of E. B. Andes. He makes a drawing which is submitted to his associates for general approval and suggestions. The drawing then is taken by a patternmaker who carves a full size model from a block of plaster. The patternmaker consults the foundryman on the best method of arranging the

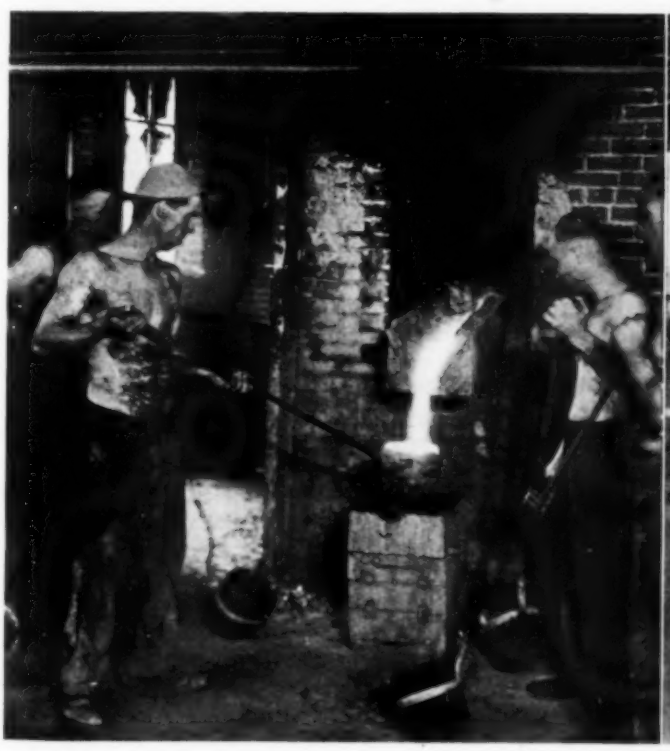


Fig. 10—The Hand Ladle Rests on a Stack of Iron Flasks Filled with Sand. Fig. 11—Molten Iron Is Carried on a Monorail System Extending from the Cupola to Both Ends of the Foundry

patterns to facilitate molding. The chief of the assembling department discusses the problem from his angle in the event that the finished object must be cast in two or more sections.

When all these preliminary points have been decided a master pattern is made. It is checked over for final verification or possible improvement and then a matchplate is made and finished with the most scrupulous accuracy. Many of the finished toys are made up of several parts and, on account of the immense number of duplicate parts cast daily, it is essential that each individual part shall resemble its brother even more closely than the proverbial peas in a pod. Outside of removing the gates, the castings receive no grinding or chipping. They must fit *as is*.

Each molder pours his own castings. Dazzling white iron runs in a practically continuous stream from the cupola spout. A steady procession of men passes in front of the spout who *catch in* right and left alternately with hand ladles. A stack of small iron flasks filled with sand under the spout supports the ladle until it is filled. The molder lifts the filled ladle and places it in one of the pendant carriers and thus relieved of the weight, pushes it along the gangway until he arrives at his floor. Here he lifts it from the carrier and proceeds to pour the iron into his molds. A high degree of skill acquired through practice enables the men to succeed each other in catching metal from the running stream without a splash or spill. Although apparently also is an essential to pour castings typified by a toy automobile wheel ¾-inch in diameter weighing one-fifth of an ounce and with 110 patterns mounted on a plate.

Iron is melted in a cupola made by the Whiting Corp., Harvey, Ill., and lined to 48 inches. The sprue and scrap is not tumbled. This material is collected in barrows and wheeled on to an elevator which takes it to the charging floor. Coke and limestone to the extent of 250 pounds of one and 40 pounds of the other are placed between the iron charges. Blast at 12 ounces pressure is supplied by a fan made by the B. F. Sturtevant Co., Hyde Park, Mass.

After the castings are knocked from the gates they are cleaned in a battery of small tumbling barrels located in

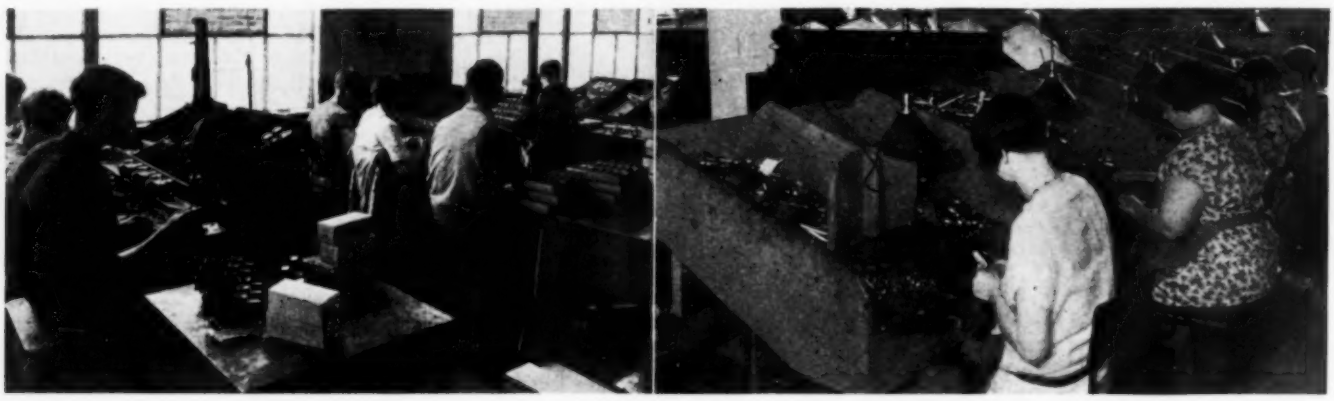


Fig. 12—One Corner of the Assembly Room Where Each Bench Is Equipped With a Small Belt Driven Riveting Machine. Fig. 13—Another Section of the Assembly Department

A central gangway extends from one end of the foundry to the other end. It is served by a monorail with pendant hand ladle carriers made by the Louden Machinery Co., Fairfield, Ia. The monorail is in two sections. One end of each section terminates near one end of the building. The other end is curved toward the cupola which is located at the east side of the building and midway from either end.

Molding practice does not differ from that found in all light work foundries. All the molds are made in snap flasks. The molding floors extend on both sides from the central gangway to the walls. Each floor is equipped with a molding machine, the greater number made by the Federal Malleable Co., Milwaukee. Some of the machines are of the hand lever type while others are operated by compressed air. A few patterns which are not amenable to a plain squeezing operation are mounted on combined jolt and squeeze machines. These molds receive a few jolts to impart the proper density to deep pockets or other tricky points and then are squeezed. From 150 to 200 molds are put up on each floor of the foundry. hazardous, this practice, as shown through many years' experience in this and other foundries, entails no greater risk than may be found in any other item of foundry operation.

Approximately 5 tons of castings are produced daily. This involves the melting of 10 tons of iron in the cupola since the gates and sprues usually weigh more than the castings. The ordinary foundry term *light castings* is exemplified here to an extra degree where the smallest castings weighed in bulk, assay 84 to the pound. The heaviest casting among the toys made in this foundry tips the scale at 7 ounces. A limited amount of outside jobbing orders are accepted, but these castings also are comparatively light, since all castings are poured from the same standard mixture.

The cupola charge of 2000 pounds is made up of approximately half and half high silicon pig iron and return gates, sprues and scrap which yields a 3.00 per cent silicon content in the castings. Soft iron is an essential where many of the castings are subjected to high speed drilling operations. Exceptionally hot, fluid iron a room adjoining the molding shop. Stars and castings from these barrels later are taken to the sorting benches where the castings are picked over by hand and distributed among the metal containers in which they are carried to various points in the plant depending on their character. Thus some are taken directly to the assembling benches. Others are taken to drilling machines and a considerable volume is taken to the nickeling department.

Castings to be nickeled are given a second cleaning in a number of tilting barrels partly filled with sand and water. These barrels revolve in an inclined position and the castings emerge perfectly clean and highly polished. They then are washed and placed in the nickel plating tanks. From here they are taken to the assembling stations.

Experience gained over a period of years shows that three colors, red, blue and yellow, appeal most strongly to buyers and—presumably—to the ultimate owners of cast iron toys. At the Andes plant part of the output is covered with these brilliant colors while the remainder is covered with

lighter shades of the same colors. The castings are attached to wire hooks suspended from horizontal rods of a conveyor. At the lowest point the castings are dipped in a tray containing an enamel paint of the desired color. Then conveyors carry them aloft through two drying ovens made by Young Bros. Co., Detroit.

Dried and shining in their brightly colored enamel cover, the castings are removed from the conveyor on the second story floor and taken to various benches where they are assembled by deft fingered young men and women. Usually this means joining the parts together and burring the ends of a small rivet on a small belt driven riveting machine. From the assembling benches the toys are taken to the packing room where they are given a final inspection, wrapped in tissue paper and packed in carboard containers for shipment.

Many ingenious kinks and processes in the assembling department originated in the inventive brain of E. B. Andes. One machine in which he takes a legitimate pride drills the center hole in toy automobile wheels. Confronted with the problem of stepping up production on this job he called in an expert machine tool builder to design a special machine. The expert said he could build a machine for $800 that would drill 3000 wheels per day. That did not appeal to E. B. The price was too high and the promised output was too low. He designed and built one of his own at a cost of $100 on which a boy gets a daily production of 15,000.

Yes, Virginia, there is a Santa Clause! He still carries the sack, fills the stockings and benevolently notes down the requests from millions of innocent and trusting little hearts, but whisper—just between ourselves—he is a silent partner in the Andes Foundry Co., of Lancaster, Pa., and kinda depends on Eugene B. Andes to see that the bag is filled.

A. I. M. E. Establishes New Record

The recent annual meeting of the American Institute of Mining and Metallurgical Engineers held in New York, Feb. 17 to 21 established a new record in the institute's history with an attendance of over 1500. Simultaneous technical sessions were held each morning and afternoon of the four days. On Tuesday morning the annual business meeting was held and the officers elected for the ensuing year were announced. William H. Bassett, American Brass Co., Waterbury, Conn., was elected president; Henry Krumb, Salt Lake City, Utah, and Scott Turner, bureau of mines, Washington, were elected vice presidents; Karl Eilers, New York, was re-elected treasurer as was H. Foster Bain, secretary of the institute.

The iron and steel division opened its proceedings on Wednesday afternoon with the announcement of the election of the following officers: W. J. MacKenzie, Interstate Iron & Steel Co., Chicago, chairman; C. S. Robinson, Youngstown Sheet & Tube Co., Youngstown, O., J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala., and C. E. Meissner, Chrome Steel Works, Carteret, N. J., vice presidents, and Thomas T. Read, New York, secretary. Papers presented at the technical session which followed included: "Production of Gray Iron from Steel Scrap in the Electrical Furnace," by T. F. Baily; and "Reclaiming Steel Foundry Sands," by A. H. Dierker. On Thursday the papers presented included, "Rate of Carbon Elimination and Degree of Oxidation of the Metal Bath in Basic Open-hearth Practice, II," by A. L. Field, and "A new Method for Determining Iron Oxide in Liquid Steel," by C. H. Herty Jr., J. M. Gaines Jr., H. Freeman, and M. W. Lightner. On Thursday afternoon Dr. Zay Jeffries presented the annual Howe memorial lecture on "The Future of the American Iron and Steel Industry."

The institute of metals division began its sessions on Tuesday afternoon with a session on corrosion and general subjects. Wednesday morning and afternoon were devoted to copper and brass until 4 p.m. when Dr. S. L. Hoyt delivered the annual lecture choosing as his subject, "Hard Metal Carbides and Cemented Tungsten Carbide."

A symposium on the melting and casting of nonferrous metals took place Thursday at which the following papers were included: "The Influence of Silicon in Red Foundry Brasses," by H. M. St. John, G. K. Eggleston and T. Rynalski; "Monel Metal and Nickel Foundry Practice," by E. S. Wheeler; "Melting Bearing Bronze in Open-flame Furnaces," by E. R. Darby; "Effects of Oxidation and Certain Impurities in Bronze," by J. W. Bolton and S. A. Weigand, and "Oxides in Brass," by O. W. Ellis. The annual division dinner was held Thursday evening at the Savoy-Plaza hotel. G. H. Clamer, Ajax Metal Co., Philadelphia, spoke on, "The Induction Furnace for the Melting of Metals." Officers named for the coming year by the institute of metals division are: Dr. Zay Jeffries, Aluminum Co. of America, Cleveland, chairman; J. R. Freeman bureau of standards, Washington and Sam Tour, Lucius Pitkin Inc., New York, vice chairmen. W. M. Corse, Washington, was re-elected secretary.

The annual dinner of the American Institute of Mining and Metallurgical Engineers was held Wednesday even ing at the Commodore hotel. At the dinner two medals and one prize were awarded. The James Douglas medal was presented to J. V. N. Dorr and James Aston received the Robert W. Hunt medal. The J. E. Johnston Jr. award for 1930 was presented to William S. Unger.

Fig. 14—*Plaster, Wood and Metal Patterns Are Made in a Well Equipped Pattern Shop.* *Fig.* 15—*Approximately Half of the Metal Melted One Day Is Returned To the Cupola the Following Day in the Form of Gates*

Foundry Training?

Should Schools *Teach Engineers* Foundry Practice?

This Letter Started the Fireworks

THE PENNSYLVANIA STATE COLLEGE
STATE COLLEGE, PA.

Dear Sir:

Recently I addressed an inquiry to Mr. R. E. Kennedy, technical secretary of the American Foundrymen's association, asking for an expression of his opinion on the importance of teaching foundry practice as a part of an engineering course. In his reply he advised me to write to you as one who is actively connected with the foundry industry and who is interested in engineering education.

Our foundry has become so old that it is no longer economical to repair it. Neither is it equipped to illustrate in a satisfactory fashion, modern foundry practice. Whether there will be anything done toward providing a new building and equipment depends upon the attitude of the college administration. At present there is a serious feeling that the foundry is a relatively less important unit of our productive equipment and that it is becoming more so owing to the replacement of castings by forgings, steel stampings and steel shapes assembled by welding. I am sure that there is a serious doubt whether the college is justified in building and equipping a foundry even though it is conceded that our present shop is unsatisfactory.

* * * *

While it is true that we are not attempting to train boys for jobs as molders, we have always felt that a certain knowledge of foundry practice is essential for an engineer, even though his work is not closely connected with the foundry industry.

* * * *

C. W. BEESE,
Head, Department of Industrial Engineering.

JUST a few weeks ago, the question of policy of an engineering school, recognized and respected throughout the east, projected a question into the center of the foundry world that has produced an exceedingly interesting response. This question, carried in the letter from Prof. C. W. Beese, head of the department of industrial engineering, The State College of Pennsylvania, is pertinent. On its face it merely asks for a definite answer as to whether this institution should rebuild its foundry laboratory.

Back of this will be found several unspoken questions and indication of a chasm in interests between engineers and foundrymen. The first question which occurs and which is inferred, is whether the foundry industry is declining toward extinction. The next is the inquiry, can an engineering school teach a student anything worth while about foundry practice. Another phase is what encouragement does the foundry industry offer a young man. Finally, an unspoken thought is found in this letter which probably is reflected in the minds of many members of the faculties of our engineering colleges, what would foundrymen advise in the way of a course which would supply them with men and at the same time give engineers an appreciation of the properties and uses of castings?

Perhaps Professor Beese does not hold entire accord with this breakdown of his inquiry and the exposure of the other points of interrogation that search through the thoughts of educators and leaders of the foundry industry. However, the response indicates their existence.

This inquiry was sent in duplicate to a large number of men identified with the foundry industry, through the instance of C. E. Hoyt, executive secretary and R. E. Kennedy, technical secretary of the American Foundrymen's association Robert E. Belt, A. J. Tuscany and Granville P. Rogers, who direct the activities of the malleable, gray iron and steel trade associations of the foundry industry. Some of these answers are presented by the consent of the writers and Prof. Beese and in the interest of crystalizing thought on the subject. A prompt refutation of the rumored early demise of the foundry industry features practically every one of the answers received. Harold S. Falk, vice president and works manager of the Falk Corp., Milwaukee, widely known for his interest and activity in training and apprenticeship works, says:

> It is considerably beyond the imagination of most of us to believe that the art of foundry practice will be useless in the very near future. There is, however, no question that welding has, in many instances, replaced both iron and steel castings, but I think that it is equally true, and will be more so in the future, that castings can be made to replace welded structures.
>
> In the development of this art of welding, I think you will find that the pendulum will swing far beyond the practical application of welding and will soon return to a normal position.
>
> Personally, I cannot conceive of the foundry art declining to such an extent that it would not be necessary for some of our educational institutions to carry on. The foundryman is going to be called on to meet welded structural competition and I feel certain, with the developments that have taken place in recent years, the industry will not be found wanting when this time comes.
>
> Perhaps it is quite unfortunate that more of our engineers are not familiar with foundry practice. It is quite true that very few of them really have any foundry contact, which perhaps explains many of the impossible designs that are presented to the foundry for manufacture, and in many instances also for the high prices quoted by foundries.
>
> It seems to me that a combination of casting and welding is going to be one solution of this problem. Certain parts of intricate designs can certainly be made more cheaply as castings than from welded structures and, on the other hand, certain parts which make a casting very

complicated and difficult could easily be added to a casting in the form of welded sections.

F. A. Lorenz Jr, assistant vice president, American Steel Foundries, Chicago, and chairman of the steel division of the American Foundrymen's association states that in his opinion the foundry industry is in need of trained engineers; that it will not be supplanted for many years to come; its output steadily is increasing; new uses are being found for foundry products every day and that a knowledge of cast metals is essential to every engineer. He says:

> The word "foundry" in the industry of the United States embraces, of course, many branches of the industry and represents in the aggregate a very large percentage of the invested capital of the United States of America. It is our feeling the foundry offers one of the most promising fields for the endeavor of the young engineer as it is a well-recognized fact that this industry has lagged behind other industries in the adoption of modern production methods. An upgrading of the foremen, superintendents, and foundry executives is certainly desirable and a recognized necessity by the more progressive of the foundry companies in the United States.
>
> Each year the productive capacity of steel foundries has been increasing. Perhaps reference to the directory of iron and steel works of the United States and Canada, and particularly to the list of plants making steel castings in the United States and Canada, will serve to give a quick summary of the magnitude of the industry.
>
> As a point of interest to you, we have canvassed several of our engineering graduates and asked them their opinion of the training they received in the foundry while at several engineering schools. They have all unqualifiedly stated they thought it did them very little good and was of very little benefit to them in their experience with the American Steel Foundries.

Mr. Lorenze believes that the engineering college cannot be expected to train foundry executives ready for service in industry, but that an effort should be made to acquaint engineers with castings. He summarizes as follows:

1. It is important to have all engineers familiar with foundry practices.
2. The *purpose* of the engineering college is to teach useful engineering knowledge relating to the industries.
3. The *method* of teaching this information regarding the foundry industry is the real question before you.
4. It is important to get the most information to all of the engineering students so they may become acquainted with the industry in general; know its possibilities and limitations from the viewpoint of a desirable occupation and at the same time become acquainted with the physical limitations surrounding the use of castings from a design and practical engineering standpoint.
5. Pennsylvania State college would not be justified in equipping a foundry. The scope of the work which may be taught by this method of instruction is too limited to be of specific value to an engineer entering a career in foundry industry.
6. More information of real value to the engineering student could be obtained by spending the time now devoted to foundry laboratory attending lecture courses, reading related texts, viewing industrial motion pictures with explanatory lectures, viewing photographs, reading trade publications and catalogues, studying models of molds, viewing actual castings as cast and as processed through the various steps in the foundry than by actually making a few molds or cores and seeing a few heats made in a small cupola.
7. Student engineers waste time in "foundry" at many of our engineering colleges where admittedly the equipment is so meager and antiquated—not to mention the knowledge of the instructors with the actual state of the foundry art.

Edward A. Steinfuth, president, Cascade Foundry Co., Erie, Pa., discusses the matter from the standpoint of a gray iron foundryman, a successful one and also a graduate of Penn State. He says:

> We of the industry insist that this is not a decadent industry, though unethical advertising and false propaganda might lead some educators to think so. As is always the case, the pendulum has swung too far toward forgings, stampings, welded fabrication, etc., and I think a little investigation on your part will show that it has started to swing back toward the point of equilibrium. It has been just such things as the abandonment of college foundries, etc., that those who would discredit the foundry industry for their own selfish interests have fed upon.
>
> I am thoroughly familiar with how Penn State has been hampered for sufficient funds for just such things as this during the past 25 years that I have known the school as student and alumnus. In my time the course in foundry practice and the building in which it was housed was a disgrace to the engineering school of the great industrial state of Pennsylvania. My apprenticeship was under my father, (the late Jacob C. Steinfurth) who had 52 years of practical experience in the business and I think I was well qualified to judge the college's shortcomings in this respect even during my student years.
>
> Visits to the campus during recent years disclosed the fact that the college was doing a little more for the foundry industry of the state than it did back in 1908, in that it had secured a competent and practical foundryman in the person of Mr. Hall. But to think of abolishing the foundry course now or let it retrogress in any way, is breaking faith with one of the old basic industries of our commonwealth.

The foundry industry has a warm proponent in the person of Dr. Richard Moldenke, Watchung, N. J., who from his knowledge of instructional methods and practices in this country and abroad brings a comparison between American and Euro-

Malleable Speaking

THE approximate production of malleable iron castings in the United States by years taken from the reports of the Department of Commerce, shows a steady increase in production for the 6-year period, or from 790,000 tons in 1924 to 947,000 tons in 1929. The production for 1929 is, without doubt, the biggest of any year in the history of the industry.

The production of steel castings, as reported by the American Iron & Steel Institute, likewise shows an increase of about the same rate as that for malleable castings. The production in 1924 was 1,255,276 tons and in 1929, the figure not yet announced for the full calendar year, will exceed 1,500,000 tons.

There are no production figures available from any source on gray iron for the country as a whole. It is entirely probable, however, that the 1929 production was the greatest in the history of the industry. Certainly the automotive industry, undoubtedly the largest single consuming industry, used a greater quantity of gray iron in 1929 than in any former year. There is no evidence of a decline in the volume of the production of nonferrous castings.

Therefore it would seem, that there is no basis for the propaganda which stamping and welding interests are spreading that stampings are rapidly replacing castings, and one would think that instruction on foundry practice, as a part of an engineering course, would be as essential today as any time in the past, if not more essential, as castings are serving nearly every line of productive activity which formerly used castings and in addition a great many lines in which formerly castings played no important part.

ROBERT E. BELT
Secretary-Treasurer,
Malleable Iron Research Institute

pean practices as concerns the employment of technical men in foundries. He holds firm in the faith that cast products will survive and prosper. He says:

> In contradistinction to the European situation, where all technical men about a foundry are college men, from assistant superintendent up, and even below the rank of foremen there are technical graduates gaining experience in special departments, we here have this situation only in the foundries of the very large industrial establishments, as the Westinghouse and General Electric Co. interests, the Worthington Pump Co., etc. Hence, purely for teaching foundry practice for a future livelihood for the young men you have, the field is too narrow.
>
> The young engineers sent out by your college and all the others of like standing, will all of them soon be in position to direct the purchase of the foundry product, and it is becoming more and more imperative that they know all about how this foundry product is made. Otherwise they will find themselves —and their employers naturally also —at the mercy of the uninformed and careless—to put it mild, foundryman. Even our greater universities are recognizing this fact and special courses are arranged for in foundry procedure—even if rather primitive—which must be taken by the engineering students. When such a graduate gets into a foundry for purposes of placing an order later on, he is at least not hopelessly lost.

The viewpoint of a practical foundry consultant, who in addition is a professor of metallurgy at Rensselaer Polytechnic institute, is illuminating. This is furnished by Prof. Enrique Touceda, Albany, N. Y., consulting engineer, Malleable Iron Research institute, who says:

> The tendency among manufacturers of textile machinery right along has been to modernize and increase the capacity of their foundries. I am very well acquainted with this industry and at this writing I have been unable to recall any plant that makes use of stampings or welded parts. Personally I cannot well conceive how these could be used by them except to a very inconsequential degree.
>
> In the automotive field one attempt was made, but it was quickly abandoned due to the multiplicity of machines, and the great amount of room and labor required; failure finally resulting from inability to obtain production. I am familiar with conditions in the agricultural field and the foregoing remarks would apply with equal force.
>
> In locomotive construction the use of pressed or welded parts would to any extent whatever be out of the question. However, in car construction there is a fair chance that these parts may be used to some advantage and substitutions to some extent prove practical. There would be a chance of some headway being made in the conveyor field I believe, and I gather that substantial inroads have been made to date.
>
> A large tonnage of castings is used in the manufacture of refrigeration machinery of which the York Ice Machinery Corp. is a fair example. In this industry I can recall no case where a substitution would look inviting.
>
> In the case of fittings the opportunity would be scant.
>
> Now there are two facts to consider. One is that the foundries generally are making a product superior to what has been obtained in the past, both as to physical properties and tolerance limits on designs so intricate that they could hardly be duplicated commercially in a pressed or built up part. Also, the manufacturer finds it neither satisfactory nor economical to multiply his manufacturing processes.
>
> The other is that neither the pressed nor the built up part have the intrinsic merit that is claimed through the use of the term steel, and the trade is beginning to see where the weaknesses lie.
>
> The die maintenance cost for replacement and blankingout parts to be pressed is dependent upon the hardness of the steel. Consequently the very softest steel is purchasd, such as will have a yield point as low as 29,500 pounds per square inch. Recent tests of some pressed parts and malleable castings designed for the same purpose, were much in favor of the latter by reason of the buckling of the pressed part long before actual failure took place in the casting. Tests within the past week resulted the same on bolts made of malleable iron and steel of the same dimensions, by reason of the much higher yield point of the castings and because the bolt manufacturer cannot use a stiffer steel and still compete in price.
>
> Without entering into detail, the welded part is structurally at fault in many instances at the welds, and unless subsequently annealed to correct structural conditions and remove internal strains the malleable and steel castings easily may be superior to the welded structure.
>
> The question is not whether a pressed or welded part is superior in all particulars to any type of casting, but whether this would hold true on the character of each type that can be purchased at approximately the same price.
>
> It might be illuminating to investigate how the American Foundrymen's association has grown in membership during the past ten years.
>
> On a production basis my slant is that it will be found that neither the pressed or welded part can meet the needs; that while each method can and will make inroads in the casting field under certain favorable conditions no serious results will follow if foundries keep up to date.

The willingness of foundrymen to take college graduates, when they can find them is indicated in several of the responses. Louis B. Bond, manager of the Christiana Machine Co., Christiana, Pa., notes this when he says:

> We feel it would be a great mistake on the part of State College to eliminate the course in foundry practice and the practical instruction, which, no doubt, can be obtained in your experimental foundry.
>
> The writer is himself a graduate mechanical engineer of Lehigh university, and has always regretted that we are not able to obtain this practical instruction at that institution. In order to obtain the practical instruction which he felt necessary he was forced to get it not only during the summer months, but during a year spent at a neighboring machine shop and foundry.
>
> No doubt, other concerns like ourselves are interested in securing sales representatives with engineering training, who are acquainted with foundry practice, etc.

The viewpoint of the thoroughly sucessful foundryman, who is not a college man is shown in a letter from T. S. Quinn, treasurer, Lebanon Steel Foundry, Lebanon, Pa. who says in part;

> In the work which you attempt to do, I appreciate that it is important that your college be so physically equipped and your courses so arranged as to keep everything reasonably proportionate so that the importance of one course of study will not become distorted at the expense of another. Here I should tell you that I do not have this perspective; how could I, who did not go to college myself? However, I am interested as I have three boys of my own, and hope to make a foundryman out of at least one of the three.
>
> I am intensely interested and confess to be a little amused that the question should arise in the minds of the heads of State College as to whether or not the same reasons continue to exist as in the past that make desirable a foundry training as part of an engineering course. Who am I to say that foundry training should have been a part of every boys' training taking a scientific course? But I can tell you that if there ever was justification that same reasoning applies with as much force today as it did then.

Gray Iron Hopeful

I FEEL that by all means, you should continue that department. Regardless of the fact of whether a small percentage of your graduates enter a foundry as a regular type of employment, they should have a good knowledge of the fundamentals of foundry practice.

I feel you would be acting very wisely to insist on a new modern foundry department. Insist that it be kept up-to-date, and I know it will pay you excellent dividends.

ARTHUR J. TUSCANY
Manager,
Gray Iron Institute

Many other exceedingly interesting viewpoints are presented, which space limitation does not permit THE FOUNDRY to quote in full at this time. R. J. Doty, plant manager, Reading Steel Casting Co., Reading, Pa. contradicts the statement that the foundry is becomingly relatively less important. He points to expansion of facilities, the construction of the ten million dollar plant of the General Steel Casting Co., Eddystone, Pa., built by foreseeing men of long experience who believe in the future of the industry, being a case in point. He believes foundries can use college educated men and that engineering graduates need a knowledge of castings and foundry methods.

E. H. Williams, president, Vulcan Mold & Iron Co., with his intimate contact with the entire iron and steel industry holds that a good working knowledge of the foundry industry is essential. He says that while some progress has been made in substituting forging and stampings, the foundry always will have a foremost part in manufacturing and industrial uses. S. J. Wagner, manager, Gray Iron Foundry Co., Reading, Pa. holds that the foundry industry is a growing factor and that it is going away from old fashioned methods by adopting machines and equipment that require engineering ability to design and build. B. H. Johnson, Florence, Pipe & Foundry Co., Florence, N. J., similarly holds that the use of welded materials has been carried too far, that four or five years ago the foundry industry was lagging, but that now it has made a big start along progressive lines.

H. D. Miles, president, Buffalo Foundry & Machine Co., Buffalo, N. Y., says that it will be a long time if ever before the foundry industry is thrown into the discard. However, he has found that college graduates are not interested in foundry work—an unfortunate truth. C. R. McCann, sales-manager, H. L. Dixon Co., Pittsburgh, blames foundrymen for some of the present conditions in the industry but states that gray iron is coming back.

A brief summary of opinions expressed by many foundrymen is carried in the letter of Maj. R. A. Bull, director, Electric Steel Founders' Research group who says:

> I have reason to think that the situation as to the obsolete nature of the equipment prevailing in your own institution is quite like that existing in numerous similar colleges. Unquestionably it is a condition that ought to be remedied, and in which foundrymen should seriously interest themselves.
>
> There is no doubt about the fact that engineering students will be much better equipped if they acquire a better knowledge of the manufacture and use of castings than they are getting; and that such better knowledge is obtainable only through the active cooperation of far-sighted foundrymen.
>
> The situation is of consequence not only with respect to the desirability of getting engineering students to adopt foundry work as an occupation for themselves, but chiefly in connection with the more intelligent professional work engineers can do when they know the possibilities of the foundry and are made familiar with many important factors like design, which have so much to do with the satisfactory use of castings.
>
> Unquestionably we cannot reasonably and profitably adapt courses in an institution such as yours, for the purpose of making molders. The principal job is to give the coming engineers a useful knowledge of the possibilities of the foundry, and the way in which they, as engineers, may cooperate with foundrymen to the best advantage of all concerned.

This From Steel

IT IS important that your engineers should be familiar with foundry practice. While it is quite possible that but few of them go actually into foundry work, still unless they are well grounded in modern foundry practice and progress, I cannot conceive how they could classify themselves as efficient engineers.

A thorough knowledge of foundry practice as it exists today is, in my judgment, essential for an engineer, even though his work is not connected with the foundry industry. As to how far your college should go, is a matter for the college authorities to decide.

GRANVILLE P. ROGERS
Managing-Director,
Steel Founders Society
of America

Falk Apprentices Receive Yearly Awards

The annual banquet of the Falk Apprentice association, Milwaukee, for members, graduate apprentices, officials, foremen and department heads of the corporation was held on Monday, Feb. 17, at the Pfister hotel. Entertainment was furnished by members of the association. Instrumental selections were played by Ann Bachowski, Melvin Schoechert, Ivan Gukich, Roman Zareczny and Elmer Jaeschke. Short addresses were given by George Maurer, co-operative apprentice, and C. J. Freund, apprentice supervisor.

The principal feature of the evening was the distribution of awards to winners of competitions in the various departments. The awards were made by H. S. Falk, vice president, works manager of the Falk Corp. All apprentices are graded regularly during the year in workmanship, conduct, school work, attendance and punctuality and the winners of the competition are determined by the general average in these points at the end of the year.

Prizes for first, second and third place winners in each department consists of tools, instruments and books to the value of $75, $35, and $25, respectively, except that there are only two prizes in the drafting department, amounting to $75 and $35 and one prize in the drafting assistant department amounting to $25. Every prize includes a year's subscription to an appropriate magazine. Publications included are, THE FOUNDRY, *American Machinist, Machinery and Mechanical Engineering.*

The winners of first, second and third place in various departments were as follows:

Foundry department, Joe Monfre, Albin Halquist and Frank Kofler.

Machine shop, Frank Bozdeck, Ray Schmidt and George Winn.

Pattern shop, Felix Zagorski, William Zemke and Lyman Moffitt.

The winners of first and second prizes in the drafting department were Ralph Ham and Charles Sanhuber, respectively, and the first prize in the drafting assistant department was won by Ann Bachowski.

A special award of a year's tuition in the college of engineering of Marquette university was awarded to Carl Frister, who was the leading co-operative student in the shop.

Under the regulations of the contest, the same apprentice may not win an award two years in succession but receives a bonus in pay instead. Such bonus awards and other special bonus awards were made to the following: Anton Johannsen, Arthur Heinrichs, Elmer Davis, Roman Zareczny, Paul Knowles, Allen Weston, Frank Marcey, Walter Westergreen, Milton Erdmann, Charles Hiltman, Harry Paepcke, Louis Kubricky, John Neske and Paul Woytek.

The meeting was arranged by the following committee: Thurber George, Albin Halquist, Paul Knowles and Steve Chowenskie. William Hager was toastmaster.

Fred Anderson, formerly connected with the Newaygo Engineering Co., Newaygo, Mich., now is associated with the National Engineering Co., Chicago, engineering department.

SAND CONTROL
Increases Economy in the Foundry

Research by Analyses and Syntheses Gives Data on Effect of Various Components in Molding Sand

By O. E. J. Abrahamson

STUDENTS of the metallurgical, physical and chemical laws that govern the economical production of sound castings first had to overcome many strongly intrenched traditions and prejudice that existed in the foundry industry. One problem was how to overcome the bias and remove at least some of the ancient customs that prevailed in connection with the purchase and use of one of the most important and perhaps least understood group of materials that enter into the foundry namely; molding sand and molding sand ingredients.

Suitable Methods Lacking

Resistance to the purchase of these raw materials on the basis of laboratory findings as well as to the introduction of technical control in use of sand and other mold ingredients was quite natural when it is considered that natural or seminatural (blended) molding sands, suitable to their particular class of work, were available to most foundries at relatively low cost and freight. Also the absence of a proper understanding of the needs of the foundry by the technical or laboratory staff was due chiefly to the lack of suitable methods of test and analysis.

Realizing the importance and need for a thorough knowledge of molding sands and molding materials, their composition and behavior, various organizations, technical schools and individuals, have in recent years devoted a great deal of time and money to research work in this promising field. As a result of all this work some definite methods of testing molding sands and a better understanding of the functions and influences of the various ingredients in molding sand mixtures exist. Also a clearer perception as to what constitutes a good molding sand for different types of castings is evident.

At the same time with the advent of modern molding machinery, the need for the economical mass production of castings to meet the volume demand and the keen competition within the foundry industry, executives began to realize the importance of having accurate knowledge and control not only over the mechanical, metallurgical and core practice phases of the foundry, but also over the materials from which molds are made.

Is Fundamental

IN RECENT years considerable investigation has been carried on to determine some of the factors involved in placing molding sand under technical supervision. Most of this work has been performed on sand as it is obtained from the pits. However, in the present series of articles of which this is the first, the influence of the various molding sand components was obtained by analysis and synthesis. The information to be presented is the culmination of many years work on the subject of molding sand by the author. The material has been applied practically in using molding sand economically and reducing foundry losses in one of the leading foundry corporations.

This was particularly brought to the fore in the transition of the hand operated floor foundries to mechanically operated continuous ones. The same sand, which in many instances had functioned to entire satisfaction in the hand operated foundry and therefore had been saved carefully during the change to a continuous basis, failed utterly when introduced in the new system. This occurred in spite of the fact that the old patterns and flask equipment was used and the same old molders employed.

The reason for this failure is obvious when we stop to consider a few of the outstanding differences insofar as molding sand is concerned between a hand operated foundry and a mechanical, continuous one. In the hand or floor foundry the sand is used only once a day and any change taking place in the sand due to unusual or improper conditions would be noticed in a matter of a day or two and proper correction made. Further, the skilled molder knows how to ram or otherwise prepare the molds if the sand does not have the right *feel* or is over or under tempered. The casting is allowed to cool in the mold and therefore, carries little of the molding sand with it when shaken out. The sand is mixed with new sand, water, etc., and allowed to temper for several hours before it is used again.

Tempering Time Reduced

In the continuous foundry, on the other hand, the sand usually is turned over four or five times an hour or as much as fifty times a day. This not only means that the time for tempering is cut to a minimum but also that any change that would occur in a floor foundry heap over a period of one week would happen in a continuous foundry operation in a little over an hour. True enough the sand is not burned out as fast in proportion in the continuous foundry as is the case in the floor foundry, since the castings are shaken out hot. However, more molding sand is carried out with the castings and invariably, due to the speed of the shaking out operation, more burnt core sand is spilled into the molding sand.

Eventually, the executive, when contemplating some of the grief of his new, modern foundry, came to a full realization that the matter of molding

sand was not as simple as he had thought heretofore. He realized that the inexpensive sand that previously performed satisfactorily was neither inexpensive nor satisfactory. He also became aware of the immediate need for some sort of technical control of the molding sand and molding sand ingredients in his foundry. Consequently the technical staff received support and encouragement in its work on molding sand problems. That the confidence so vested was not misplaced is evident when some of the great economies that have been made possible because of this work are considered.

One large foundry firm for instance has obtained economies amounting to several million dollars annually due directly or indirectly to the application of laboratory investigation to the treatment of molding sand, the handling of sand in continuous foundry operations, reclamation of waste sand and laboratory control. Such results naturally are not brought about over night but are the gradual accomplishments over a period of years. Step by step the secrets of the influence of molding sand, as to grade, ingredients and treatment, upon the production of sound and better castings were bared by painstaking research work and constant follow-up in the foundry.

A tremendous amount of highly commendable work has been done by a large number of investigators of molding sand and allied subjects. However, before a thorough understanding of these materials and the multitude of problems connected with them may be had by foundries, further intensive studies will have to be made by research men and foundry technologists.

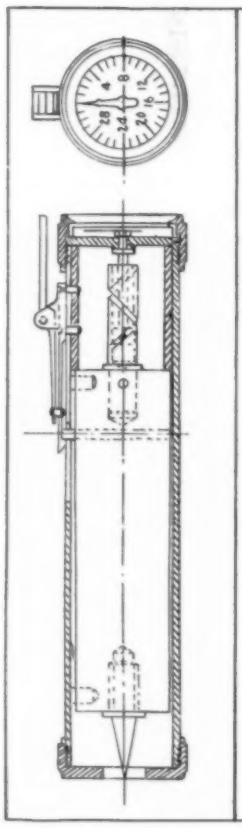
Analytical Methods Change

In the early studies of molding sands, chemical analysis, ultimate as well as proximate, were the chief tests made. However, little or no information of actual foundry value is obtained by chemical analysis and realizing this, investigators proceeded along different lines, employing at first sieve analysis, the finest sieves being 100 meshes to the inch. Later on, as better and more standard sieves were made, sieves were employed down to 300 or more meshes per inch and the so-called *clay substance* was washed out by various means before making the screen analysis on the dried grain residue.

Still later the necessity for knowing something about the ability of the sand to allow gases to escape was realized and various methods for testing the permeability of molding sands were developed and studied. At about the same time it also became apparent that ordinary washing not only removed the actual colloidal substance but also a great deal of the finer grains or silt. To get a more definite understanding of the bonding value of a sand, the phenomenon of clay and similar substances to absorb certain dyes in fixed ratios was employed in the testing of molding sands. The dye absorption method has considerable merit. However, it is difficult or next to impossible to employ it in daily or routine testing of foundry sands due to the many elements that affect readings, such as organic impurities in the sand, the clarifying of the solution containing the unabsorbed dye, etc.

In recent years, the testing of molding sands has proceeded along an almost entirely mechanical line, employing strength testing machinery of various types.

During the past several years that the author has studied molding sand and conducted extensive research work on the qualities and characteristics of this material, practically every suggested method as well as every testing device has been employed and utilized. This was done in an effort to discover the most dependable, and at the same time, the most rapid method for the determination of the qualities of a molding sand that were deemed desirable for the best results in surface conditions of the castings and casting losses in the foundry.



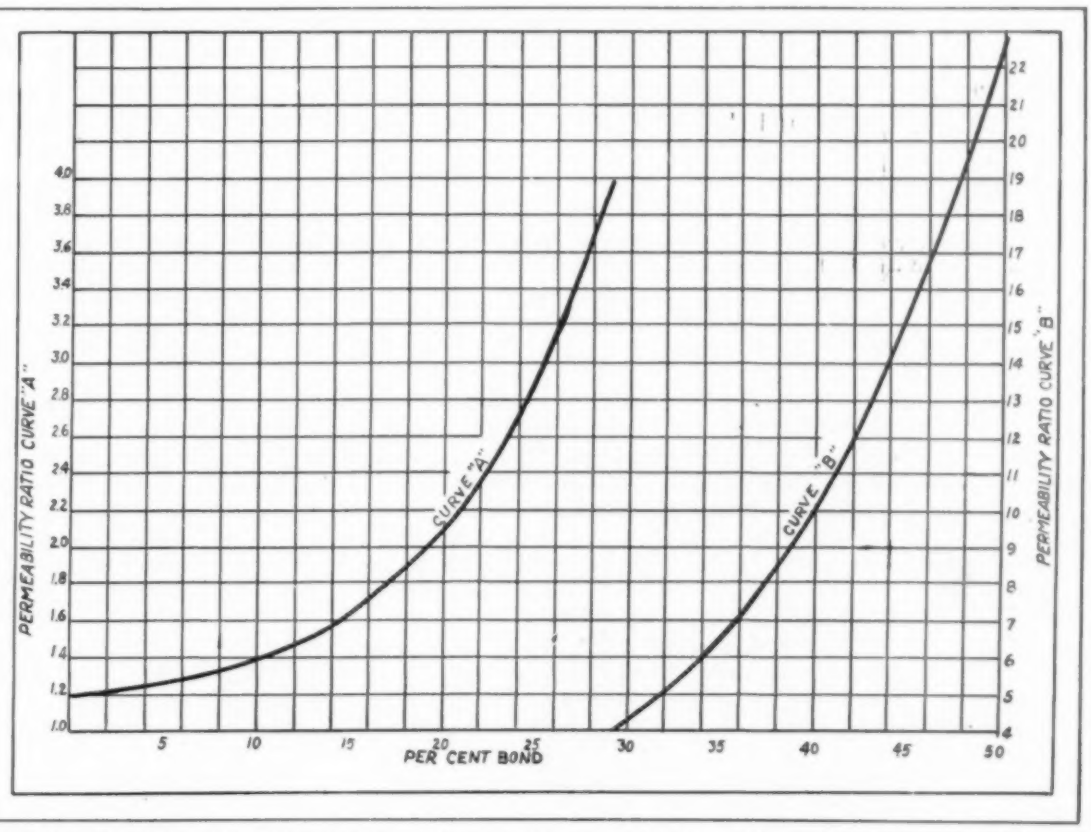


FIG. 1—(LEFT)—HARDNESS TESTING GAGE FOR SAND MOLDS. FIG. 2—(RIGHT)—WITH LOW BOND CONTENT THE RATIO BETWEEN PERMEABILITY AND BOND IS LOW WHILE WITH BOND CONTENTS OVER 30 PER CENT THE RATIO IS HIGH AND INCREASES RAPIDLY

Work by many investigators overemphasizes the importance of obtaining data on the tensile, transverse or crushing strength of molding sand without due regard to the actual bond of the sand or its grain structure. During the studies of molding sands from all parts of the United States east of the Mississippi river, as well as on European sands and synthetic molding sands, it was found that strength is not by any means related to colloidal bond. Also it is too much dependent on such variables as moisture, mixing, grain structure, etc., and therefore is not always a criterion on which suitable changes in the molding sand may be based.

Early in the investigations of molding sands it became apparent that what really was needed were methods for the rapid determination of the qualities of a sand that are of most importance in the foundry, namely bond and permeability, or to use the term more often heard in the foundry, *openness* of the sand. The activity of the bond as well as the permeability are dependent in a great measure on the percentage of moisture present. The necessity for a rapid and reliable moisture test also was evident. Several satisfactory, rapid methods for the determination of moisture have been described previously in THE FOUNDRY.

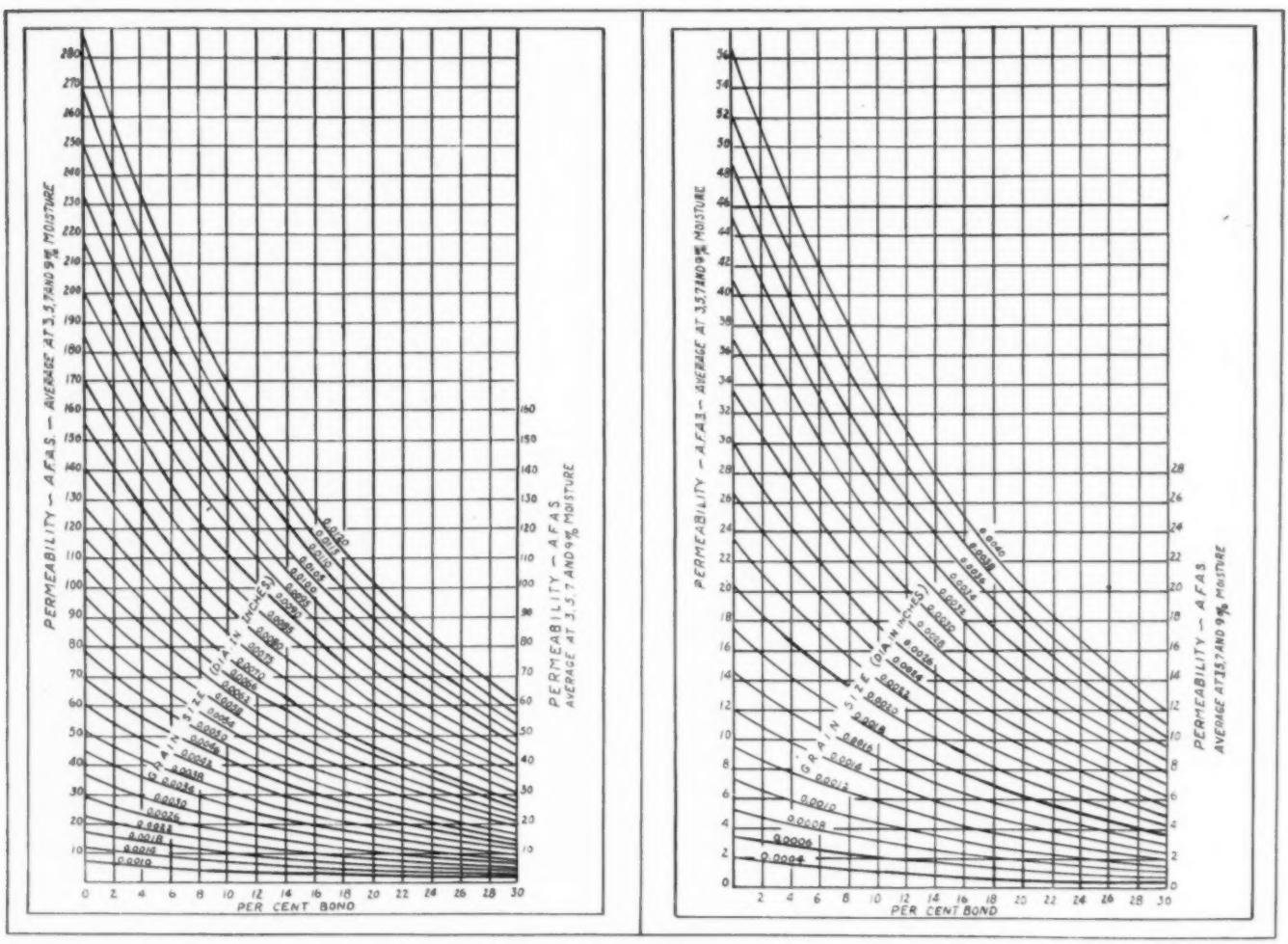
Develop Rapid Methods

Rapid methods for bond and permeability determinations were developed and put in operation about five years ago. However, the data on which these methods were based were rather scant and obtained with somewhat crude testing devices. Shortly after they had been put in use it became apparent that a more thorough study would have to be made. This study covered the influence that bond and fine particles of a noncolloidal nature had upon permeabilities, the relationship of moisture to permeabilities for sands with various percentages of bond and fine particles of a noncolloidal nature, etc.

As a consequence, intensive work on the discovery of fundamental facts about molding sands and the development of accurate and rapid methods for their analysis were instituted at this time, using standard, modern testing devices. In addition use also was made of a hardness testing device as shown in Fig. 1. The use of this device is simple and gives good results.

After the permeability for three rams has been determined, the tube is turned upside down, so that the side which was nearest the base plate is up; the other side of the sand specimen resting on a stripping column. The hardness is determined by holding the device firmly on the specimen and allowing the plunger to drop by pressing on the lever on the outside of the device. This process may be repeated a number of times but it is usually entirely satisfactory to take only five readings, one in the center and four toward the edge. The more uniformly the sand has been prepared, the more uniform are the readings. Occasionally, in testing sands directly from the foundry in daily routine work, the plunger may strike a shot of iron, a big stone or a lump of hard clay. This reading being entirely different from the others is not incorporated in the average hardness.

Since in most production foundries it is neither necessary nor desirable to have a sand containing a large percentage of grains on the 20 mesh sieve most of the research work to be described was conducted on sands


PERMEABILITY — A.F.A.S. — AVERAGE AT 3, 5, 7 AND 9% MOISTURE
PERMEABILITY — A.F.A.S. AVERAGE AT 3, 5, 7 AND 9% MOISTURE
PER CENT BOND
PERMEABILITY — A.F.A.S. — AVERAGE AT 3, 5, 7 AND 9% MOISTURE
PERMEABILITY — A.F.A.S. AVERAGE AT 3, 5, 7 AND 9% MOISTURE
PER CENT BOND

FIGS. 3 AND 4—CURVES SHOWING THE RELATIONSHIP BETWEEN PERCENTAGE OF BOND, SIZE OF SAND GRAIN AND THE PERMEABILITY DETERMINED ACCORDING TO THE A.F.A. STANDARD METHOD

having little or nothing on the 20 mesh sieve. When using the hardness testing device on sands that are coarser than this it was found that when grains larger than 20 mesh sieve exceeded 10 per cent, the hardness readings—depending somewhat on the structure of the grains—are more or less incorrect and the method therefore should be used with discretion on such sands.

Collect Many Samples

Most investigators have confined themselves entirely to the studying of molding sands and molding sand mixtures as obtained without breaking down the sand and determining the influence of the various ingredients. Consequently, it was decided that to obtain this information it would be necessary to secure representative samples of sand and clay from all parts of the United States. These were mixed in equal proportions, so as to obtain a fair average of various types of grains and bond and the mixtures then were taken apart to study the combinations that could be made with the segregated ingredients.

After 20 such samples had been collected and mixed together, the work of taking the mixture apart commenced. The grains were washed free from bonding materials in an elaborately set up series of apparatus. The water containing the bond and other suspended matters was collected and concentrated as the washing process proceeded. After the grains had been washed clean they were dried and screened through a standard set of sieves including the following meshes: 10, 20, 35, 65, 100, 150, 200, 270, 300 and 320 to the inch. After a sufficient amount of grains (2000 grams) had been obtained for each sieve, the grains were subjected to a further treatment with strong alkali, water, acid and water until perfectly clean uniform grains resulted.

In the meantime the wash water containing the bonding material had been concentrated till it had a syrupy consistency. Chemical analysis of this substance as well as a microscopic study of the same revealed that there still was considerable grain mixed with the bond. After a great many futile attempts to separate this material still further it finally was found that about 6 per cent of the material in question on a dry basis mixed with 1 per cent ammonia and 93 per cent water effected an almost immediate separation of grains and bond.

The liquid containing the bond was neutralized carefully with hydrochloric acid and the supernatant liquid, as the bond settled out, siphoned off. Water then was added and siphoned off repeatedly until only a trace of hydrochloric acid remained. The bond was dried at a low temperature and powdered to 100 mesh.

Chemical analysis of this bond or bonding material showed the following: Loss on ignition, 11.1 per cent; silica, 52.54 per cent; aluminum oxide, 27.96 per cent, and iron oxide 7.90 per cent. The Field rational method gave the following result: Clayey substance, 87.44 per cent; feldspar, 3.21 per cent, and quartz, 9.25 per cent. The dye absorption test gave 83 milligrams of dye per gram of sand and the fusion point was 3160 degrees Fahr. A microscopic study of the material revealed no grain or particle larger than 0.0002-inch in diameter. The majority of the particles were considerably less than 0.0001-inch in diameter.

The material, as shown by the analysis and by the various combinations that may be calculated from the same, as well as by the microscopic study, would indicate that there was some free silica, as well as mineral grains in the substance. However, from a practical point of view and until better methods of separation on a large scale may be developed it was decided to call this material 100 per cent bond and use it as such in the studies.

Put Components Together

The grain separated out from the concentrate was subjected to the same treatment as the larger grains classified by means of sieves as previously outlined. These fine grains, as nearly as could be determined, showed an average diameter of a little over 0.0005 inch.

At this juncture the work of putting the sand together again was started. Definite amounts of bond and grains were mixed dry. Later on sufficient water to make the mixture pasty was added and the mixture was dried carefully at low temperatures. After considerable preliminary work on fine, heavily bonded molding sands, it was found that to obtain uniform results in testing, especially with the permeability device, it was essential that the sample to be analyzed be submitted to a standard treatment.

Briefly this consisted of taking a little over 200 grams of the sand or mixture to be tested, and which previously had been dried, placing it in a mortar and all compound grains broken up by grinding with a wooden pestle for one minute. This prevents any crushing of the actual grains. The sand then was put through a 20 mesh sieve and whatever stayed on the 20 returned to the mortar and the process repeated until all the material except true 20 mesh grains had been passed through this particular sieve.

Two hundred grams of the prepared sand mixtures, minus the weight of the water intended for the test, then were weighed out and placed in the mortar with the water wanted in the finished mixture. From ½ to 1 per cent extra water was added to compensate for loss in the mixing process. The water was incorporated thoroughly with the sand mixture by the aid of the pestle and a spatula. A sufficient amount of this mixture was weighed out to make a two-inch specimen in the permeability test tube with two rams of the standard ramming device.

Tempering Not Necessary

By adhering to the above procedure no difficulties were encountered in obtaining absolute—or nearly so—checks on the various tests made.

It also was found that by proceeding as outlined it was not necessary to allow time for tempering. On the contrary, it was found that sands tested immediately after being mixed as described and sands permitted to temper for as much as two weeks showed no variation in the results.

After every conceivable mixture of pure grain and bond had been prepared as described and tested at different moisture contents the results of all these tests were tabulated and studied. The results of these studies on permeability in mixtures of clean, uniform grain and bond at different degrees of ramming and moisture content are shown in Figs. 2, 3, and 4. One, three and six rams with the standard ramming device was employed on most of the tests.

The term *average permeability* which is used later on in this series of articles and on the charts is the average of the permeabilities at 3, 5, 7, and 9 per cent of moisture and with three rams of the standard ramming device obtained. However, orifice plates in the testing device were not used, since the results obtained with the plates are inaccurate. Depending on the percentage of bond, fine grains, coarse grains, etc., the optimum moisture content in respect to permeability will be from 1 per cent up to as high as 15 or 16 per cent. However, for average molding sands, containing up to 20 per cent of colloidal bond, the high point will be from 12 to 13 per cent moisture. From this it is apparent that to strike an average permeability that could be used for all sands it would be necessary to incorporate a full range of moisture contents. After considerable experimenting it was found that satisfactory results were obtained by using 3, 5, 7 and 9 per cent moisture.

American Brass Foundry Practice

By Charles Vickers

Part VI—Gating the Casting

A PATTERN for a bronze pump body arranged in the mold for upright pouring is shown in Fig. 8. This is a common way of making such castings, but one that many molders do not approve. They feel that it is better to pour such castings on a slight incline from the horizontal with the gate and sprue at right angles to the pattern. The castings are poured through the cope, somewhat as shown in Fig. 9. However, where they are poured vertically as shown in Fig. 8, the percentage of leakers is much too high to suit the producer. The molds are made in an ordinary 2-part flask of the type shown at *A* in Fig. 10. It will be noted that there are three holes in one of the ends, and a lug on the opposite end. In lifting off and otherwise handling the cope, the molder inserts one or more fingers into the holes to obtain a hold.

Gives Advantages

The pattern, gate and runner as well as any shrink balls needed, are molded together. They all are on the same horizontal plane as the pattern, so there is no sprue to mold or cut, and no gates if the side is made properly. This is one advantage the vertical method has over the horizontal one. The mold is practically complete when the cope is lifted off and the patterns drawn. Some finishing, of course, is required and then the two halves of the flask are closed, clamped together and set on the floor.

In making *upright* work two bottom boards are used on each flask, one on the drag, the other on the cope. As pouring is facilitated by having the mold inclined a little toward the gangway, one of the two boards is allowed to overlap the lug or bottom end of the flask an inch or two more than the other. Since the flasks stand on the ends of the boards, they incline toward the gangway, instead of being strictly vertical. In pouring the molder rests his pot against the top edge of the board and with that as a fulcrum, tilts the pot so the stream hits the hole in the flask. The board usually is protected against burning by a loose piece of angle iron which is placed on it at this point. One of the boards is shown at *B*, Fig. 10, and it will be noted that they are expensive due to the manner in which they are made. This board, it can be seen is made like a drawing board with the cleats dovetailed across the ends of the main board, instead of being nailed simply across one side as in the case of boards for horizontal molding.

Board Not Suitable

For this latter method the drawing board type is not suitable, because in the case of horizontally-poured molds they could not be set flat on the floor, and for tilted molds, the lower end would be in contact with the floor. Consequently, there would be considerable difficulty in picking them up when shaking out, as the fingers could not get under the boards. On the other hand the side-cleated board is not convenient for the making of vertically-poured molds as the regular brass molder's screw clamps, shown at *C* in Fig. 10, would have to be opened at least 2 inches more than with the drawing board type, both in clamping up and in loosening for shaking the casting from the flask.

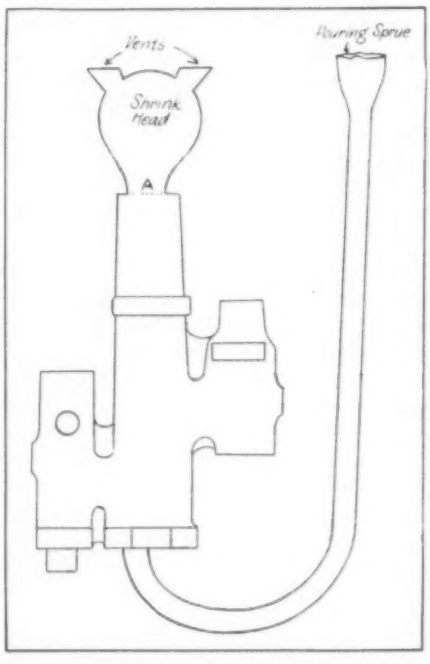


FIG. 8—METHOD OF CASTING PUMP BODIES VERTICALLY

For this reason a foundry only occasionally pouring molds in the vertical position, will use the U-shaped iron clamp having both ends bent to a right angle. These are easily knocked off the poured molds, but they also are loosened all too easily on the molds before they are poured. Unless the clamps are secured by wooden wedges the mold may spring open and may be lost.

In the case under discussion the pump body was cast solid, that is without cores, and the vertical runner was of small diameter. It merely served the purpose of filling the mold, and so neither fed nor bled the casting. Instead, the upper part of the casting itself fed the lower portion, although not enough to destroy its outside contour. The casting appeared perfect as it came from the sand because the shrinkage was internal and concealed. When the mold was filling, the metal was chilling and shrinking constantly and feeding itself as it rose. For that reason the shape of the casting was maintained. The shrink ball was filled last with almost congealed metal and when the pouring temperature used for a mold got rather low, the narrow neck at *A*, Fig. 8, set almost as quickly as the movement of the metal ceased. Therefore the shrink ball was a dismal failure as a feeder, and the upper part of the casting was bled by the lower.

Loss Was Too High

All the castings poured in this manner were not failures. Some of them were good, but enough of them were failures to render this method of making them impractical. The percentage of loss was too high for the job to provide a legitimate profit, so a change was compulsory. Two methods of feeding a bronze casting are by hydrostatic pressure combined with hot metal, and by an outside reserve supply of molten metal located so that it will feed the lower parts of the casting where shrinkage occurs by gravity. In this case there was comparatively no hydrostatic pressure, so the shrink ball was intended as a reserve. All the trouble of leakage was

due to the fact that the shrink ball was too small and its connection to the casting was too small. Consequently, unless the metal was quite hot, it set before the casting, and left the casting to feed itself when it had reached the eutectic stage in solidifying.

The remedy was a larger shrink ball with a connection to the top of the pump body covering the total area of that part of the casting at *A*, Fig. 8. In Fig. 9, the same casting is shown but molded for horizontal pouring, or slightly inclined from the horizontal. *B* is a riser which is slightly larger in diameter than the body of the casting to which it is connected. The pouring sprue is located at *C* and the connecting channel *D* is cut, or molded from a *set* pattern, having a choke which is a part that is materially contracted to hold back the stream of metal and check its force. However, the most important function of the choke is to enable the pouring head to be kept filled with metal until the castings are entirely filled. In this way the head holds most of the dross that has found its way in with the stream floating in the sprue, instead of the mold.

Use Various Gates

Sometimes instead of the choke, the molder will use a strainer core, or some sort of a skimming gate. The object to be attained is the same with all of them, namely, to strain or hold back bits of dross, charcoal, coke or other debris until the mold is filled and thus prevent them from becoming a part of the casting, or castings. In pouring a chunky piece of bronze, every effort should be made to keep the sprue head filled with metal and never let it sink down, for it will always carry some dross and this will be sucked into the mold to the detriment of the casting.

The choke, and also most of the skimming gates are not used in the case of the smaller castings, because there is no room for such contrivances in the mold. All available space is utilized for patterns to secure the greatest possible production. Also, the gating system is small and acts as a strainer for any coarse pieces of coke or charcoal. It is easier to skim the metal before it enters the sprue, as the stream is smaller than in the case of a large and weighty casting.

It is surprising how much metal will pass through a small channel in pouring a large casting. Hot, fluid cast iron or any alloy of similar fluidity and specific gravity, will supply 5 tons of metal per hour through a ½-inch hole; a ⅝-inch hole will supply 10 tons per hour, and a ¾-inch hole will supply 15 tons per hour. It is easy to cut a channel in molding sand that will carry metal away so fast that the pourer cannot keep pace with it. Consequently, the sprue is always empty while the mold is being poured, and the metal goes down like water into a sewer carrying all the nonmetallic substances that escape the skimmer along with it right into the mold.

There are almost as many methods of gating and risering molds as there

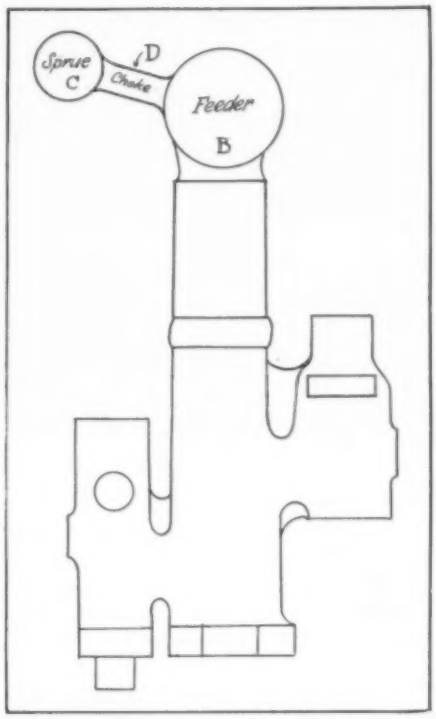


FIG. 9—ARRANGEMENT FOR HORIZONTAL CASTING OF PUMP BODIES

are individuals making them. It is probable that each one thinks his own method the best, and really so long as casting losses are low and production satisfactory, it is advisable to let well enough alone. There is little standardization in the brass foundry business as nearly every foundry has its own methods, layout, furnaces, grades of sand and ideas, so the wandering molder usually has his trials and tribulations the first few years of his travels.

Occasionally the methods used in a particular shop are adapted well to the class of castings being made there, but just as frequently, they are not. The newcomer frequently must adapt himself to the ways of the foundry he happens to land in, and keep his views and past experiences to himself. However, many firms have open minds and are always willing to accept a suggestion from any source.

For example, in a certain foundry a valued customer had one pattern on which the loss was a serious setback to making a profit on the rest of his work for the month in which the pattern was used. It was simply a grid about 36 inches long, 20 inches wide and ⅛-inch thick, containing diamond-shaped holes. It was desired in red brass which had a golden color when polished. Yellow brass with aluminum would not do at all.

The pattern was not straight and flat, but it was bent lengthwise about one-third of its width at an angle of about 20 degrees. The pattern had to be molded on the floor which resulted in quite a large mold for a little metal. Had every casting been good, a substantial loss would have resulted on the transaction, for as is usual with brass foundries, that archaic method of selling the casting by the pound prevailed. The customer was an average close buyer, so this difficult casting was included with the others and at the same price per pound.

Cold Shuts Resulted

The shape of this casting was such that due to the lace-curtain effect of its surface there was no possibility of distributing small drop gates over its surface. It had to be run from the sides, and when more than one pot was tried, the result was cold shuts wherever the opposing streams of metal met in the grid.

The source of loss was misruns and the best molders in the shop all tried it to their sorrow. It was dominating the shop, as it always did at every appearance when a wandering molder appeared on the scene one morning. He could not help but see the pile of scrap that had accumulated, so he asked the victim who had been elected to the job this time, if he would mind if he asked the foreman to let him try them. The foreman was glad to have a volunteer and the molder was given the job right away. The grid was nothing but a frame on three sides of the open work. One of the long sides was the raw edge of half a diamond, and parallel with this the molder placed a broad, flat runner planed from a strip of wood. The runner was 2½ inches wide, ¼-inch thick and as long as the casting. From the runner narrow gates were cut to each diamond point. A sprue 2½ inches in diameter was made and located in the center of the broad runner. The mold was skin dried and closed, but instead of the ordinary funnel-shaped sprue head, the molder built a runner box made in an iron flask on top of the large sprue. The runner box was large compared to the mold. In fact it would hold twice the amount of metal sufficient to make

the casting. When this work was completed the metal was ready. The molder had it melted in a small crucible holding just enough metal to run the casting and gates, with enough over to fill up the sprue about 1½ inches deep. The metal was heated as hot as possible, and handled with the utmost speed in skimming and carrying off. A small shank in which the pot fitted loosely was used, and instead of pouring the mold in the ordinary manner, the molder inverted the pot with its metal, upside down into the large opening of the runner box. The latter was used over and over again as it was made of sand and clay, bonded with water glass and thoroughly dried. The result of this procedure was that every casting was a complete one, and as there was almost no pressure on the mold, the diamond-shaped holes came without straining.

Use Finger Gate

When such castings as stove plate patterns are wanted in brass, the best way to gate them for red brass is to use the *finger gate* of the stove plate molder. These gates are usually cast iron patterns consisting of a narrow body, long enough to carry about five fingers. These gates are set in strategic positions on the cope side of the pattern and are rammed up with the cope. The main body of the gate pattern is deep enough to form a dish into which the metal is poured, and this dish is kept filled during the pouring of the mold. The fingers are all in a row, like the fingers of the hand. The fingers are round and about the thickness of a lead pencil.

After the cope is lifted, a circular depression is made on each opening of the finger gates, using the handle of the trowel. The depression is made on the cavity side of the cope and when finished makes a boss on the casting. The act of pressing in the round end of the trowel crushes in the gate a little. This crush is wiped out by using a small taper stick of hard wood about 8 inches long which is a trifle larger in diameter at the thick end than the hole made by the finger gate. It is pushed through each gate hole from the imprint side, and that action reams out the holes leaving them smooth and free of all burrs that would wash sand into the mold. While it takes many words to describe, the operation is done in a few seconds.

For example such a pattern casting as for an oven door for a household stove should be gated in the manner just described. Several finger gates are used and each one is poured with its own pot of metal. The most satisfactory way of pouring such gated castings is with iron molder's hand ladles. The metal should be carried off by men who know how to use a hand ladle, as there is more of a trick in doing this than the unaccustomed man would suppose. Otherwise, use small crucibles in hand shanks, that enable the pourer to poise over the finger gate dish before starting his pour. All pourers on one casting should start at once.

Sometimes, and all too often, castings with broad, and thin, flat or curved surfaces are poured in brass foundries through gates arranged outside of and parallel with the pattern

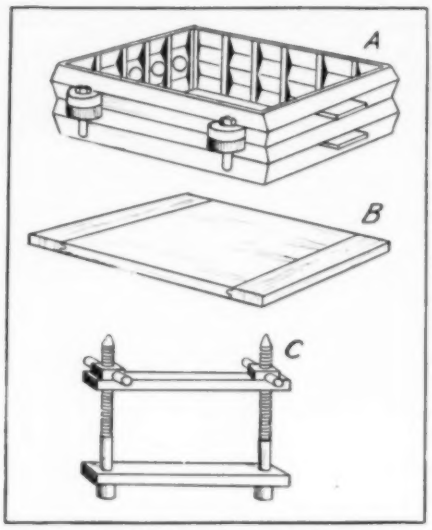


FIG. 10—SHOWS FLASK, BOARDS AND MOLDER'S CLAMP

and consisting of a long channel carrying branches to the pattern. The result is usually a much strained casting, or else the center has failed to run. There is also an even chance that the flask will be sprung and the metal will flood the floor. That method of gating thin castings should not be encouraged.

Youngstown Company Names Officers

W. J. Wallis has been elected chairman of the board of the reorganized Youngstown Foundry & Machine Co., Youngstown, O.; B. G. Parker was elected president and general manager; S. K. Hine, vice president and Lloyd R. Wallis, secretary-treasurer, Roy L. Hartzell has been added to the board of directors to succeed the late A. E. Adams. In addition to Messrs. Wallis, Parker, Hine and Hartzell, F. A. Williams, Frank Purnell and Isaac Wilkoff were added to the board

Wm. C. Robinson & Son Co., Baltimore, has moved its New York office from 136 Charlton, to 288 West street.

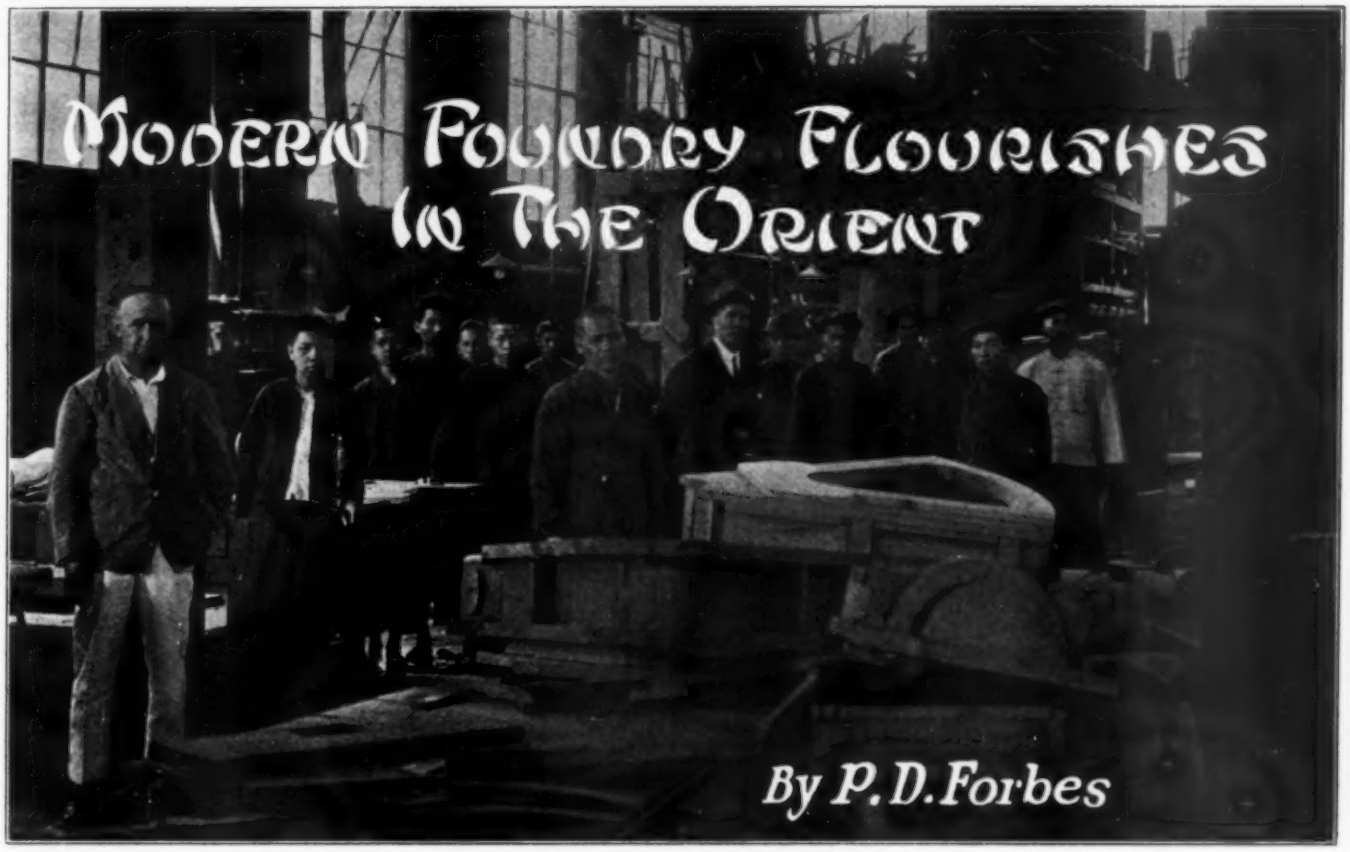
Graduate Assistantships Are Available

University of Illinois maintains 14 research graduate assistantships in the engineering experiment station at the university to aid in the conduct of engineering research. Two other assistantships have been established under the patronage of the Illinois Gas association. These assistantships have an annual stipend of $600 and freedom from all fees except matriculation and diploma fees. Half time is spent in graduate study and the remainder assisting in the conduct of engineering research. Appointments will be made for these positions in the spring and applications must be submitted to the director of the engineering experiment station not later than April 1. Nominations are based on character, scholastic attainments and promise of success in the principal line of research to which the candidate proposes to devote himself. Preference will be given to those candidates who have had practical engineering experience. Further information may be obtained by addressing the director, Engineering Experiment station, University of Illinois, Urbana, Ill.

Publishes Bulletin

A recent publication issued by the bureau of standards is entitled, "Observations on the Iron-Nitrogen System," by S. Epstein, H. C. Cross, E. C. Groesbeck and I. J. Wymore. The authors have made a study of the iron-nitrogen system through thermal analyses, microscopic examinations and X-ray analyses of nitrided electrolytic iron specimens. From the data obtained and with the diagrams of Sawyer and Fry as a basis, a modified iron-nitrogen constitution diagram tentatively has been drawn. The upper temperature horizontal noted by Sawyer also was observed but this has been ascribed to a peritectoid instead of a eutectoid transformation. Three nitrided layers were observed whereas Fry noted only two. The three layers have been designated as Fe_2N, Fe_4N and Fe_8N. Observations on several specimens of aluminum-molybdenum nitriding steels also are described. The price of the bulletin, which is Research Paper No. 126, is 20 cents.

H. H. Knowles, 625 Third street, San Francisco, has been appointed sales representative in New Mexico, Colorado, Wyoming, Montana, Idaho, Utah, Arizona, Nevada, California, Oregon and Washington for the Chesapeake Crane Corp., Baltimore.



Modern Foundry Flourishes In The Orient

By P. D. Forbes

Fig. 1—Chinese Patternmakers Work Slowly, But Turn Out Excellent Patterns

ONE of my earliest foundry acquaintances was an old, experienced molder known to every person around the place as *Professor*. He had just returned to his native Scotland after spending a three-year term as foreman molder in a foundry in India and had brought home a fund of stories and comment that made him the center of attraction, particularly to the younger members, at lunch hour and at any other hours for which they could invent an excuse.

Was Skilled Molder

The professor was a highly skilled and resourceful molder. His comments on Indian foundry practice and of the innovations he introduced, were illuminating, instructive and at times, amusing. He was gifted with a most extraordinarily fertile and vivid imagination. A useful gift, no doubt, in adding a dash of piquancy to an otherwise drab recital, but unfortunately it introduces an element of doubt in the mind of the listener.

Even with the best and most favorable intention one found difficulty in swallowing stories of lions and tigers that infested the foundry yard and curled up in empty flasks at night for a little nap; of others who calmly stalked into the shop for a drink from the water barrel or from a molder's swab pot. Stories of snakes that slipped down the runners and unexpectedly popped out through the risers looking for trouble might or might not have been true, but even up to the present *"A hae ma doots"* concerning the story of the python which entered the shop one morning and swallowed two coolies, a shovel and rammer, a snap flask and a keg of nails. The nails fixed him. Punctured his inner tire. To prove the truth of this story the professor would show three of the nails which he had recovered and utilized as substitutes for suspender buttons.

The foundry was controlled by a railroad company and the great bulk, if not all the castings, were designed for railroad service. One of the professor's greatest accomplishments was to cast 300 locomotive cylinders in one year without losing a single cylinder. None of his audience ever was guilty of the discourtesy of inquiring what possible use a single railroad had for 300 locomotive cylinders in one year.

He never tired of praising the skill of the native patternmakers. Squatting on their hunkers and with no other tool than a jack knife, they carved out patterns more rapidly than white patternmakers could knock them together in a modern shop filled with machinery and all kinds of up-to-date appliances and materials. A great country and wonderful people any way you want to look at them.

The professor and his intriguing tales almost had faded from mind over a period of nearly 30 years when they were revived recently by a visit from an old time Clydebank friend, William Wotherspoon who has been associated for the past 25 years with the Taikoo Dockyard & Engineering Co. Ltd., Hong-Kong.

To one whose entire adult life has been spent in foundries and patternshops his visit was extremely interesting, giving me as it did, first hand, reliable information of the foundry industry in the Far East.

Maintains Four Shipyards

Hong-Kong is one of the greatest sea ports in the world and maintains four shipyards. Each of these shipyards operates its own foundry. The following description, briefly summarizes the subject:

British Hong-Kong is a crown colony acquired in 1841 and lies at the mouth of the Canton river 60 miles from Canton. The island covers an area of 7 x 10 miles and the colony is supplemented by additional territory known as Kowloon on the mainland covering 397 square miles. In 1928 the population was estimated at 681,800, principally Chinese. The foreign population of which one-third is British born, is given as 14,500, or approximately 2.00 per cent. The colony suffered heavily in 1925, 1926 and 1927 in the strike and boycott of the Chinese. Hong-Kong is an important British station of great strategic value, commercially as well as naval.

FIG. 2—A CHINESE CONTRACTOR SUPPLIES THE WORKMEN AND ACTS AS FOREMAN

It is the gateway between the East and the West and one of the greatest transhipment ports in the world. Movement of shipping in 1928 was the largest in its history. Combined entrances and clearances, including junks and steam launches was 778,222 vessels of 53,402,239 tons.

Besides a large volume of marine repairs which must pass inspection under the rigid insurance laws governing ocean liners, the Hong-Kong shipyards in recent years have built a considerable number of new vessels for service on the Chinese rivers and along the coast. A total of 27 vessels were built in 1928 ranging in size from a small steam launch of 35 tons to the S. S. MATANG with a register of 1463 tons. This steamer was built by the Taikoo Dockyard & Engineering Co., and engined by the same company with an inverted, triple expansion engine of 900 horsepower. Approximately 4000 Chinese are employed in the yards and shops of this company where their efforts are directed by 50 European mechanics as foremen.

According to Mr. Wotherspoon, the Chinese workmen are extremely painstaking and also much slower than white workmen. Usually a Chinese contractor supplies the labor for any given department and the men are paid on a piece work basis. This system obtains in the foundry and pattern shop. Where men are paid on a time basis, the usual rate of pay, translated into terms of United States currency, is 10 cents per hour for molders and patternmakers.

FIG. 4—THE ANCIENT ART OF BEDDING THE PATTERNS IN THE FLOOR IS PRACTICED EXTENSIVELY IN THE FOUNDRY

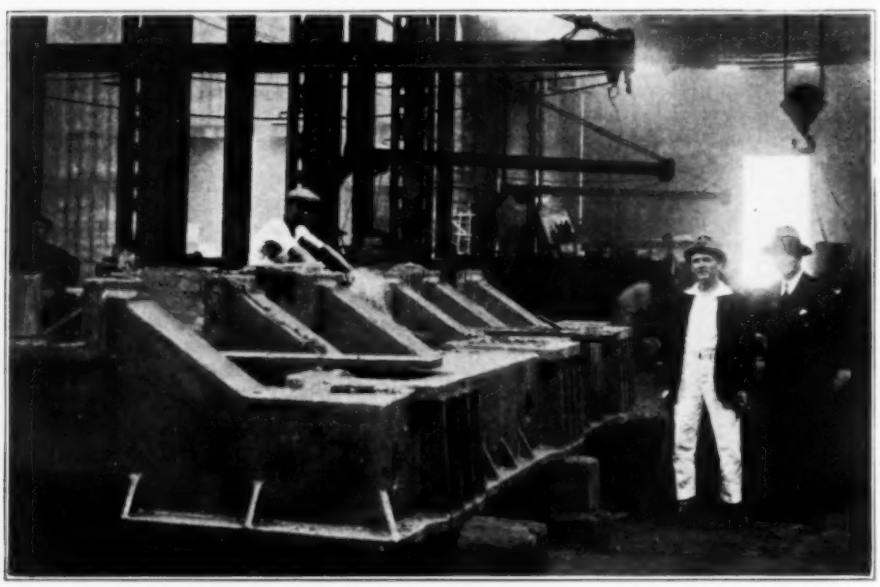


FIG. 3—CAST IRON BED PLATE, WEIGHT 11 TONS, FOR INVERTED VERTICAL ENGINE OF ABOUT 1000 HORSEPOWER

First Induction Furnace Used in Zinc Industry

The first installation of an electric furnace of the induction type for the casting of zinc recently was made at the plant of the Atlantic Zinc Works Inc., 210 Van Brunt street, Brooklyn, N. Y. The unit was made by the Ajax Metal Co., Philadelphia. The furnace uses 220 volt current passing through an electromagnetic coil which induces approximately 16,000 amperes in the molten zinc. The furnace has a capacity of 950 pounds and melts that charge in 40 minutes. The metal is poured directly into the molds instead of being poured from crucibles as was formerly the case.

W. F. Rawley has been appointed sales representative of the Oliver Machinery Co., Grand Rapids, Mich., in Indiana and Kentucky, with headquarters at 776 Emerson street, Indianapolis.

Fundamentals of
FOUNDRY PRACTICE

Directions Are Given for Forming the Joint on the Mold—Careless Joints Introduce an Element of Danger and Increase the Cleaning Cost

By Ivan Lamoureux

Interpreted in the Light of American Practice by Pat Dwyer

Part VI

TO PERMIT withdrawing the pattern, a mold usually is composed of two or more pieces maintained in alignment by guides or pins. The surfaces of the different parts in contact with each other are designated by the name of joints. In making a mold the first task is to find the joint. The location of the joint depends on the form of the object, on its nature, on its purpose. To simplify the work, the molder tries to obtain a plane surface on the bottom of the mold. However so far as possible the molder must follow the edges of the pieces, that the seams may not be apparent.

If the molder could make up the joints after he closes the mold he certainly would secure perfect castings. A ragged or uneven joint spoils the fine appearance which a casting should have. The molder therefore should take special pains in the preparation of the assembly of the joint.

If patterns in perfect condition are available for molding small castings, it will not be at all necessary to use the slicker on the joints. Unfortunately the molder frequently is given patterns that are badly designed or poorly finished. He has the troublesome job of slicking the mold joints after drawing the patterns out of the mold as a result of bad design.

Locate the Joint

LOCATION of the joint, that is the line which separates the mold into two parts, usually is determined by the pattern-maker. On simple shapes this line automatically asserts itself, but on complicated castings or on patterns designed for mass production on molding machines, the location of the joint line is an important feature and only should be fixed definitely after conference between the heads of the various departments through which the castings have to pass on their way to the shipping room or final assembly. The character, size, shape and location of the gates and runners exert an important influence on the success or lack of success which characterizes the resulting casting. So far as may be consistent with other features the gates should be designed and placed to introduce the metal as easily, quickly and with as little commotion as possible. Set gates are preferable to those cut in the sand with tools.

In large molds where the rapping of the patterns is less successful than in the smaller ones, drawing them from the molds consequently is more difficult. A joint seldom remains intact, particularly if the casting is quite high.

If the sand is broken to a considerable extent, the mold is smoothed up as follows: A small board is placed against the vertical wall of the mold to extend about 2 centimeters (¾ inch) above the upper edge of the mold. The joint is strengthened by the trowel. If the sand is only slightly crushed, the mold is repaired by going lightly over the joint with a sharp-edge slicker or outside corner tool, guided by the vertical wall of mold. The angle of the slicker should be obtuse, that is, greater than a right angle, to slope the joint back to a width of from ¾ to 1¼ inches where the cope will not touch at all.

This precaution prevents the edge from breaking at the time of assembling the parts. Fig. 48 shows how the joint was finished by a slicker pressed against the vertical wall of the mold. This same figure shows clearly that the casting has but one fin and that it will be uniform and consequently easy to remove when trimming the casting.

If the slicker is guided by the horizontal wall of the mold, that is, over the joint itself, as in Fig. 49, the vertical face of the mold near the top will be deformed, and consequently

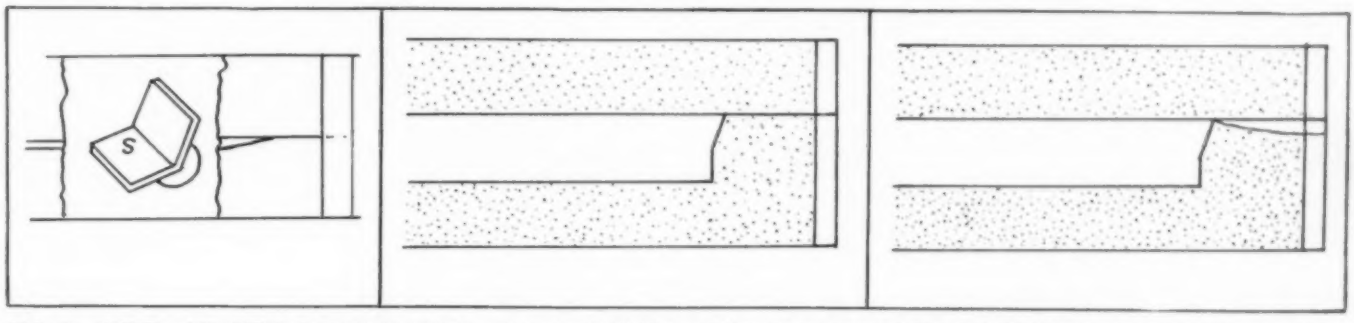
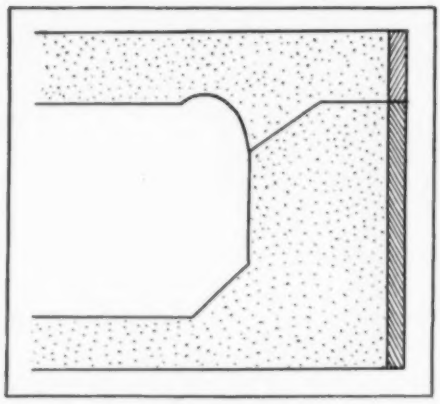
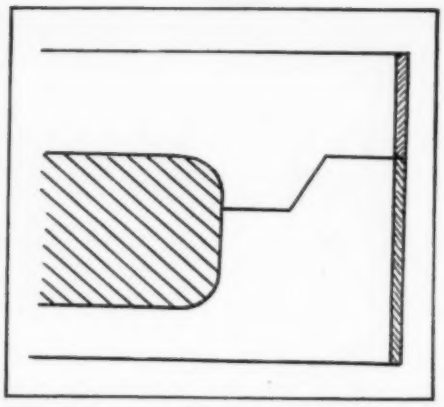


FIG. 48—(LEFT)—AN OUTSIDE CORNER SLICK. FIG. 49—(CENTER)—MOLD FACE DISTORTED BY PRESSING THE SLICKER ON THE JOINT. FIG. 50—(RIGHT)—THIS JOINT WILL CRUSH WHEN THE COPE IS LOWERED





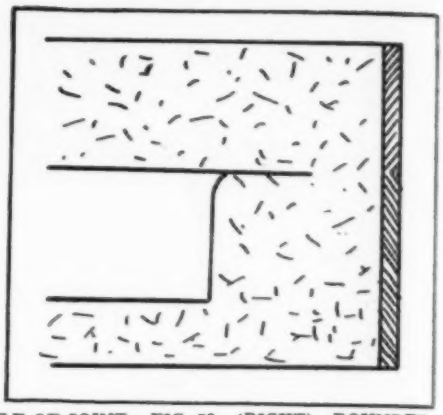


FIG. 51—(LEFT)—UNDESIRABLE TYPE OF JOINT. FIG. 52—(CENTER)—A WELL MADE STYLE OF JOINT. FIG. 53—(RIGHT)—ROUNDED JOINTS SHOULD NOT BE ALLOWED

destroy the nice appearance which the casting should have. Where part of the casting is formed in the cope and part in the drag this difference will be increased by the normal draft of the pattern, and may be sufficient to condemn the casting.

If one were to press one face of the slicker into the joint, and thus raise the edge, not only would the vertical wall of the mold be deformed but the joint would be crushed when assembling the parts and would cause the sand to slide off and spoil the casting as shown in Fig. 50.

Gives Characteristics

The sole purpose of the joint is to facilitate removal of the pattern. The molder should not polish it to the point of making it too hard, and thus obstruct escape of the gases at the moment of pouring. If the joint is rather weak or soft, the pattern easily may be rapped and may be removed from the sand without breaking the mold. If the joint is rammed hard, jarring of the pattern is difficult and it will not come out of the mold without breaking the sand. This

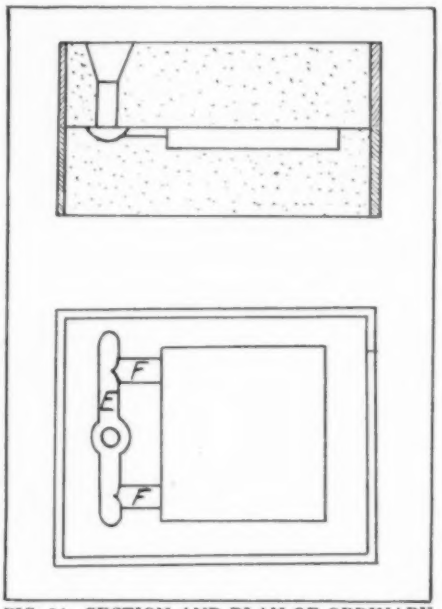


FIG. 54—SECTION AND PLAN OF ORDINARY GATES ON SMALL PLATE

requires smoothing up of the mold and of the joint.

On the prepared joint the molder should ram the cope with infinite precaution. Violent or irregular blows with the rammer will deform the joint, entailing extra work in smoothing up, and may be the cause of annoyances at the time of pouring. A hard joint restricts the escape of the gases. An uneven joint allows iron to escape. This iron covers the joint and prevents the escape of the gas. The joint should be made at or near a right angle to the vertical wall of the mold, bearing in mind of course, the slight draft given by the tool to prevent crushing the joint.

Describes Undesirable Joint

Fig. 51 represents an undesirable style of joint. Cope sand near the pattern is in a dangerous position. The corner slicker cannot pass conveniently over this acute angle edge therefore the smoothing up necessarily will have to be done with a

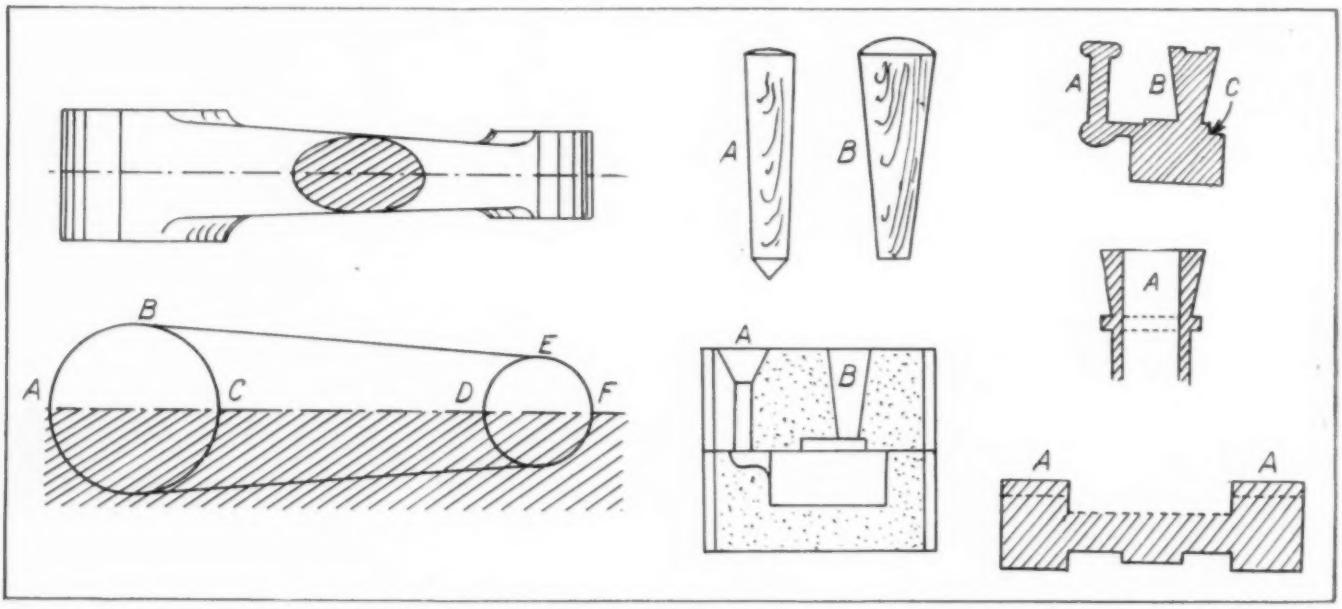


FIG. 55—(LEFT)—JOINT SHOULD FOLLOW CONTOUR OF PATTERN. FIGS. 56, 57 AND 58—(CENTER)—GATE, RISER AND METHOD OF APPLICATION. FIGS. 59, 60 AND 61—(RIGHT)—RISER, SULLAGE RING AND MACHINING STRIP ON TOP OF CASTING

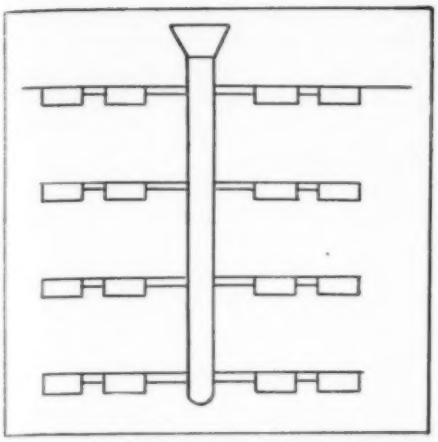


FIG. 62—ARRANGEMENT OF RUNNER AND PATTERNS FOR MULTIPLE POURING

trowel, and consequently the job will be more or less unsatisfactory. Neither can the slicker be passed over the drag edge of the mold. The two parts of the mold will not match exactly when they are put together.

Fig. 52 shows a well made up joint, hence, smoothing it up is an easy job. The slicker can be guided around conveniently. If the wall is broken while stripping the pattern, the mold can be rebuilt exactly as before.

Is Easy to Repair

Moreover, on a joint of this kind no difficulty will be found in taking certain measurements, and in moving and replacing parts which might be judged necessary for exactly lining up this or that important part. Finally, if the molder has to fit cores together, if the upper part comes even with the joint, he can regulate their height by a straightedge resting on the edges of the joint. This is impossible if the joint is not level.

The joint should have a sharp edge to leave as small fins as possible on the casting and to require the minimum of trimming.

Rounded joints as shown in Fig. 53 should be prohibited. They give a casting a disagreeable appearance and they require considerable trimming. Rounded joints show an absolute lack of taste and pride on the part of the molder making them. Every workman should feel a proper pride in his calling and should turn out nothing but irreproachable jobs. The casting that he makes will last a long time, perhaps for many years, exposed to the critical inspection of his co-workers and of the public. Defects of the joint are the most apparent. Everyone has seen posts, columns, appliances, and machine parts where the joints were unsightly. This disagreeable aspect discredits the workman who molded them and the foundry that supplied them.

In a pattern where the axes of bosses or round parts are in a horizontal plane, the joint as far as possible should conform to the shape of

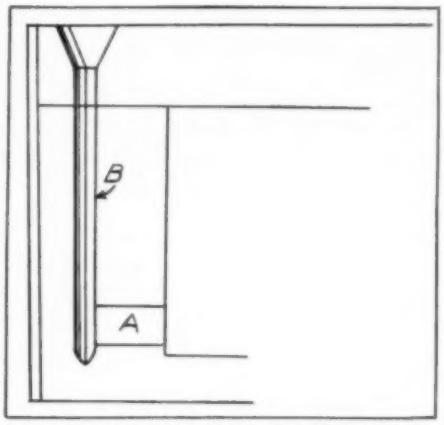


FIG. 64—LARGE GATE AT BOTTOM FACILITATES ENTRANCE OF THE METAL

these rounded parts. Thus, the small lever shown in Fig. 55, should be molded with the surface of the bosses in a vertical plane, if it is desired to secure a perfect casting. The joint should therefore be made along the composite line *A B C D E F*. At *A B C* and at *D E F* it becomes blended with the edges of the bosses,

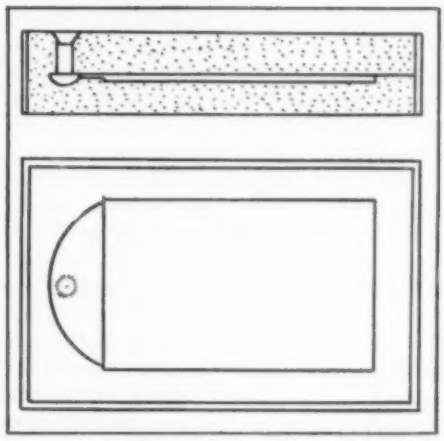


FIG. 63—GATE EXTENDS ALL THE WAY ACROSS THE END OF THE PLATE

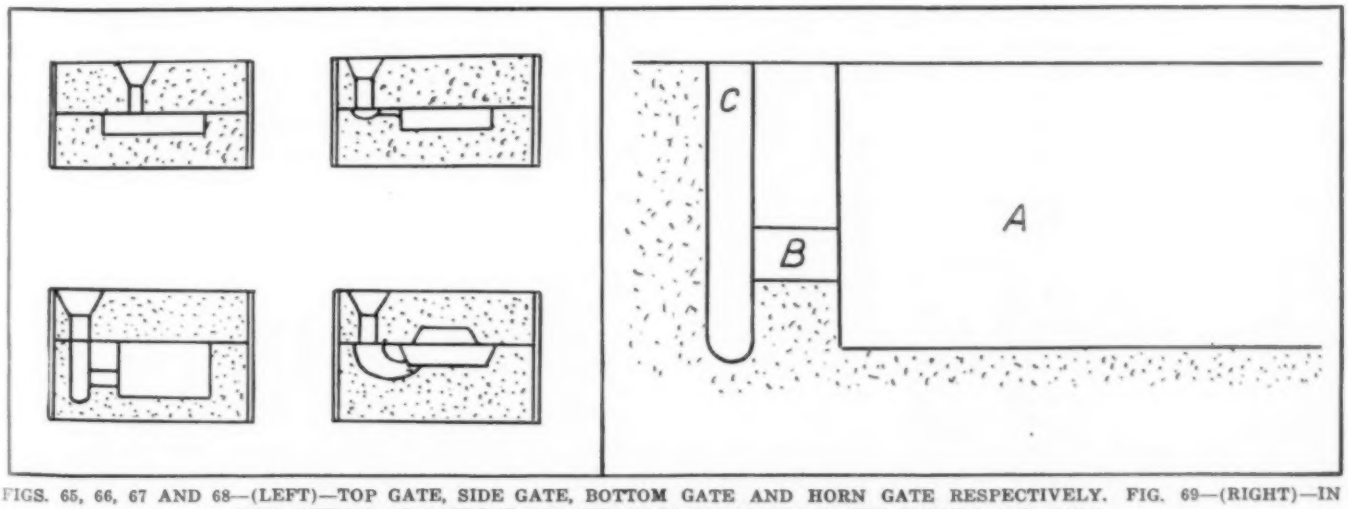
and the only apparent trace left by the joint will be noticed at *C D*.

Many molders would make the joint along *A C D F* and of course it is much easier to make than along *A B C D E F*. Unfortunately the mold would produce a casting showing traces of the joint on all four faces. After the cope is removed a certain amount of patching will be necessary. If the pattern in the drag is rapped too hard, the two parts of the mold will not go together exactly and hence will produce an ugly looking casting. Unequal surfaces on the bosses would increase the difficulties of machining the castings and would jolt the machine tools. The same remarks apply to patterns with horizontal core prints.

Machine Molding Is Different

In molding from a matchplate or on a molding machine there is no reason for applying the various principles cited, as the drags of flasks are similar to the copes. The joint is made with a great deal of precision and leaves scarcely any trace on the casting.

To prevent the sand from the cope of the mold from sticking to the sand of the lower part, the joint is



FIGS. 65, 66, 67 AND 68—(LEFT)—TOP GATE, SIDE GATE, BOTTOM GATE AND HORN GATE RESPECTIVELY. FIG. 69—(RIGHT)—IN THIS METHOD OF POURING THE STRAIN IS EQUALIZED IN THE RUNNER AND GATE

covered with a thin layer of burnt sand or white sand known as parting sand. White sand usually is the residue resulting from scraping the castings, or from the lining of pouring ladles. In molding ornamental pieces or castings of copper or the white metals, the joint may be sprinkled with crushed brick-dust. In cast iron molding, the brick dust has the great defect of favoring the fusion of the sand and of increasing the quantity of dust which the latter contains. That is why brick dust generally is not used except in molds intended for casting small pieces which cool rapidly.

In some countries, especially in France, the white sand and brick dust are replaced by a special, fine and silicious pit sand, of high silica content, pink, white or light yellow. This sand also is used for making cores. To dry it and pulverize it, the molders pour some melted iron into a hollow made in the moist white sand. In the United States a fine sand from rivers and lakes also is used for making cores. These American sands are of remarkable purity.

Use Many Partings

In the United States, pulverized charcoal is used to some extent as a parting medium on light work. Sheets of paper and oil are used quite freely to separate adjoining sand or loam surfaces in foundries where heavy castings are made. A light dust made either from tripoli or lycopodium is used by bench molders and machine molders. It is shaken from a bag over the sand face or over the face of the pattern to prevent the sand from sticking. Dust from the tumbling barrels and from the sand-blast chambers also is used in many places as a parting material.

Casting is the operation which consists in filling a suitable mold with a metal in a molten state. Obviously it does not refer to driving the metal by main force into the impression left by the pattern. Irrespective of the care exercised in ramming and venting the sand and preparing the joint, if the pouring gates and vents are not of proper size, or are wrongly located, the casting inevitably will be defective. In a later chapter the method to be followed in casting a piece and the precautions which must be taken at the time of pouring will be described. For the present it is sufficient to state that, as a general rule, the metal must not be precipitated into the mold, but must be eased in. A thin stream of water falling from a roof, will cut a groove in the ground. Molten metal likewise will wash away sand in the mold if it falls from any considerable height.

Before considering the preparation of the pouring gates and risers, an exact notion of some of the technical terms used frequently in such a study, is essential.

Wood pins of various lengths and diameters are employed to leave openings for the entrance of metal into the molds. The section may be round, square or rectangular. Some are cylindrical, others are cone-shaped. As a rule, the gate pins shown in Fig. 56 are nearly cylindrical, while the risers are cone-shaped. The first make the opening for filling the mold. The others make the risers, intended to feed the casting after it is poured. The gate pins are pointed to be stuck into the joint. The riser has a flat end to rest on the pattern surface.

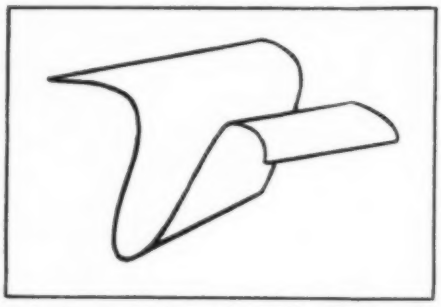


FIG. 70—A SHEET OF THIN METAL IS BENT TO ANY CONVENIENT FORM FOR A GATE CUTTER

The gate or runner is the channel which receives the metal and which directs it toward the mold. It is the impression left in the mold by the gate pin, *A*, Fig. 58.

The riser, *B*, Fig. 58 is the opening above the mold through which the gases and the air escape at the time of pouring. It permits observing the filling of the mold and prevents development of an excessive pressure. Moreover, the metal contained therein feeds the casting.

The sprue is the column of metal *A* contained in the runner shown in Fig. 59. When a casting has been poured without attached pieces, we say that it has been poured with one gate.

The shrink-head is the column of metal contained in the riser *B*, Fig. 59. The sprue and shrink-head adhere to the castings after pouring and are removed after the casting has cooled.

The *faussee volee* also known as extensions, extra metal, sullage rings, finish strips and machining allowance is a vertical extension attached to the upper part of a pattern as shown at *A*, Fig. 60, or an overthickness attached to this or that part of a pattern as at *A*, Fig. 61. This is a precaution against the danger of the cast metal shrinking, also it provides a place in which the impurities collect.

The runner *E* Fig. 54 is the name given to the channel running parallel to the side of the mold and which first receives the iron.

Gates, *F*, are the troughs which connect the runner with the mold. Various systems of pouring include: Top pouring, side pouring, side pouring at or near the bottom, pouring under the bottom (horn gate) and multiple pouring.

In top pouring Fig. 65, the metal enters the top of the mold. Sometimes through a single opening, sometimes through several, connected together to the same pouring basin. This method of pouring is used extensively.

Side pouring gates open out onto the joint, at some little distance from the edge, to check the force of the stream of iron before it reaches the mold. This system of pouring is used more extensively than any of the others.

Describes Pouring

Bottom pouring, as illustrated in Fig. 67, introduces the metal gently into the lower part of a deep or high mold and thus reduces the jolt of the metal.

The siphon or horn gate opens out into a horizontal face at the bottom of the mold. This system is used on gears and other castings where side or top pouring might cause damage to the mold.

Multiple pouring shown in Fig. 62 is applied to machine molding. The molds made in quantities by machine, are placed one on top of another and held in a press or under weights. The sprue extends down through each flask to the bottom. The metal fills the bottom tier first and then rises little by little until it fills the upper mold.

In pouring a mold, one should watch, that the metal does not damage anything. Molten iron, when projected with force against a wall or a core might dislodge some sand or cause a shifting of the core. Cascading of the metal should be avoided, but, it should not be poured intermittently. These sudden stops break up the stream and produce cold shuts.

Fig. 69 represents a bottom poured mold *A*, where the section of the gate *B* is equal to that of the runner *C*. In this case the pressure created by the stream of iron will be as great in the bottom of the mold as in the bottom of the runner.

If the section of the gate *B* is twice or three times as great as that of the runner *C*, the iron loses its pressure in the gate *B* and will pass over

quietly into the mold without damaging its walls. The object of the large gate is to lower to zero the pressure of iron in the runner. This pressure depends upon the height of the column of metal between the top of the pouring basin and the bottom of the runner. This style of gate and runner can be applied equally well to dry sand molding, to loam, and to molds in green sand.

This system of pouring *without pressure*, adopted by many foundries, was invented by the author in 1908, and a description presented for the first time to the Technical Foundry association at Liege in 1911. The molder always, on principle, should try to secure a large volume at low pressure, rather than a small volume at high pressure.

Use Large Gates

Any one of the following different systems may be employed for pouring a flat casting: For open sand molds, the bed must be well vented and the sand rammed to the proper density. The metal must be poured rapidly and without pressure. Ordinarily the mold is filled level and the pouring is effected with one trip of the ladle.

If the same casting is poured in a closed mold, it may be covered with scabs. The runner for a closed mold always is different from the open sand runner. A plate usually is poured from the side. If the branches are made narrower as shown in Fig. 54, they will project the metal against the face of the cope, then into the drag and thus cause scabs on the casting. However, with a large runner, a third the depth of the casting, Fig. 63, the metal will flow into the mold, quietly and without pressure.

Suppose the plate weighs 44 pounds. If the metal enters through a channel and two equal gates it will pass 22 pounds of metal through each of the gates. This 22 pounds falling on the same spot, will subject the sand of the mold to a severe overheating.

If the metal enters through one large gate, with a cross-section equal to 10 times the section of each of the two small branches, only one-tenth of the metal lands on the same spot. The mold will be filled rapidly, and the sand will not be overheated too heavily.

Attempting to pour the same plate in green sand presents still another inconvenience. The sand may fall from the cope side of the mold. While the iron is filling the mold, the face of the cope is heated. If the sand is weak, thin sheets strongly dried detach themselves from the face and are carried along with the iron. For that reason the mold should be filled rapidly.

To pour the plate vertically, the system of bottom pouring shown in Fig. 64 is adopted. The section of the gate *A* is twice or three times the section of the runner *B*. With top or side pouring, even with a thin or narrow gate, the stream of metal would cause scabs on the piece.

The method of pouring various types of castings most frequently encountered in practice, will be taken up later in a special chapter.

Many molders cut the gates small and narrow, with the view, they claim, of preventing slag from entering the mold. That is a mistake. If the slag is liquid or if the particles are small, nothing will stop them from going through. If the pieces of foreign material are larger than the cross-section of the gates, they will plug the passage. The pouring speed will be retarded and cold shuts will be produced. The slag should be retained in the pouring basin and the pouring should be regulated in such a way that the basin will remain constantly filled during all the time that the operation lasts. If the metal is poured too slowly or poured into too large a runner, all the slag will enter the mold.

Cuts the Gates

The Belgian workman cuts a gate with a trowel, a lifter, a double ender or any other tool. He cuts, recuts, polishes—and this series of operations naturally requires several minutes.

The American molder uses a sheet of tin, brass or copper, 5 to 6 inches square and from 0.010 to 0.020-inch thick, folded as shown in Fig. 70. After drawing the pattern he takes the gate-cutter by one of the wings and with one stroke, he hollows out the channel and required gates. The gate-cutter at the same time lifts out the sand and does not leave even a particle in the mold.

The American molder as a general rule has not more than one tool, the trowel, at his disposal. Other tools are useless to him, because the patterns turned in to the foundry always are finished to perfection, well-drafted, with all the necessary fillets, and always cut or arranged to obtain a flat joint. If, as occasionally happens, the pattern is defective or made wrong, the American molder does not slick up his mold. He will let the mold go just as the pattern leaves it.

This view which appears to obtain generally among European foundrymen is not quite correct and may be due to some extent to the fact that European visitors to American foundries almost invariably see only those that have been most highly mechanized and therefore are spectacular in their methods, system and equipment. In many general jobbing foundries where the order for one casting is the rule and not the exception, the molder is equipped with a set of tools quite as imposing as that of his European contemporary and, without drawing any invidious comparison, is just as skilled in their use. In addition to the thin sheet metal gate-cutter, he also employs, upon occasion, the trowel, the lifter and the double ender, to cut gates in the sand.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of THE FOUNDRY or of its editors.

TO THE EDITORS:

We must take exception to a statement on page 106, Feb. 1, issue of THE FOUNDRY, in part 3 of the series of articles by Ivan Lamoureux. In describing the vertical type of disk sand cutter he says: "Other cutters resembling this type have but one disk with pins. The single disk cutters clog easily. The sand thrown off the pins piles up on the inside of the machine and acts as a brake. It is then necessary to open the machine and knock off the accumulated sand."

This may be true of the European machine shown in Fig. 31 with a narrow hood, but certainly it does not apply to the single disk cutters made by the C. O. Bartlett & Snow Co., which have been installed in a great number of American foundries and which are giving unqualified satisfaction. The single disk cutter is a standard piece of equipment and forms an integral part of C. O. Bartlett & Snow sand handling equipment.

H. L. MCKINNON.
C. O. Bartlett & Snow Co.,
Cleveland.

Sand Firm Incorporated

Michigan City Core Sand Corp., Michigan City, Ind., has been incorporated by Carter H. Manny, Howard H. Spaulding and Guy R. Knickerbocker to produce sand for foundry and other industrial purposes in the northern Indiana dunes region. The company also intends to handle foundry supplies. An office has been opened at suite 1928, McCormick building, Chicago, and other sales agencies will be established. Mr. Manny has been president of the Hoosier Sand Slide Co. and was active in the former Producers' Core Sand Co. The company plans to start operations about March 15.

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Melt White Iron First

QUESTION

We are preparing to go into the white iron business in conjunction with our gray iron foundry business, and would appreciate any information that you will give us.

ANSWER

You do not state what the size of your castings will be so it is difficult to offer any suggestions on the approximate analyses for different types or section thicknesses, except that the silicon generally will be under 1 per cent. A usual method of procedure is to place the white iron mixture first on the bed of the cupola, and the number of charges will depend upon the amount of iron desired. It is good practice to put an extra heavy body of coke between the last white iron charge and the first gray iron charge to prevent mixing. The slowing up of melting at this point also will indicate the end of one and the beginning of the other.

Larger splits of coke will have to be used between white iron charges than is used with gray iron. The metal must be melted as hot as possible and poured hot also as it is quite sluggish. Materials used for the charge may be composed of 50 per cent malleable bessemer pig iron and 50 per cent return white iron scrap. Variations of this base may be made by adding from 15 to 25 per cent steel scrap, and 15 per cent gray iron scrap.

A mixture made up of 40 per cent malleable bessemer pig iron (silicon, 1 per cent); 15 per cent gray iron scrap; 20 per cent return white iron scrap and 25 per cent steel scrap gave a silicon content of 0.68 per cent silicon in the casting; a tensile strength of 30,500 pounds per square inch; transverse strength of 3200 pounds per square inch and a deflection of 0.125 inch. This iron was used in making grinding burrs for feed mills, coffee mills, etc.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

Q & A

Castings Resist Wear

QUESTION

We are contemplating the manufacture of stove grates and would like to show a good composition for this purpose. Is it necessary to add some material which will resist the action of sulphur fumes and other corrosive elements encountered in burning coal? We also have under consideration the casting of a plunger for use in oil well pumps. This plunger is 30 inches long, 6 inches in diameter and has a core approximately 3 inches in diameter. Castings previously made in ordinary gray iron did not resist wear sufficiently. Would nickel or manganese increase its wear resistance? Also can you give a composition for such a casting?

ANSWER

Cast iron which would give a white fracture would be an excellent material for grate bars if it were not so brittle. However, by increasing the silicon slightly you can obtain a mottled structure which possesses characteristics of both white and gray irons. The composition will depend on the thickness of section and since stove grates are fairly light, a silicon content around 1.50 per cent should give the desired structure. If it comes white increase the silicon, and if too gray decrease it. Keep the phosphorus around 0.20 per cent and the manganese from 0.60 to 0.80 per cent. Several grate bar manufacturers are using nickel and chromium to give added resistance to temperatures encountered. If these elements are used, hold the silicon around 1.10 per cent and use about 1 per cent nickel and 0.50 per cent chromium. Nickel and chromium may be added as ferroalloys, in the form of a nickel-chromium bearing pig iron or as an alloy of nickel and chromium.

For your pump plunger, you might try adding about 3 per cent nickel to a mixture containing about 1.45 per cent silicon. Chromium to the extent of about 1 per cent also is added. This combination is stated to have a brinell hardness around 280 but is machinable. It is also claimed resistant to hard wear. Keep the sulphur as low as possible, the phosphorus under 0.30 per cent, and the manganese around 0.70 per cent.

Q & A

Makes Mine Car Wheels

QUESTION

Can you recommend a satisfactory cupola mixture for chilled mine car wheels?

ANSWER

Mine care wheels have the following range in analysis: Silicon, 0.75 to 0.85 per cent; sulphur, under 0.095 per cent; phosphorus, 0.20 to 0.40 per cent, and manganese, 0.60 to 0.80 per cent. Higher silicon in mine car wheels compared to railroad car wheels is necessary due to smaller size. Lower sulphur is specified because many manufacturers believe that sulphur causes red shortness and trouble if the wheels are overheated in braking.

Some mine car wheel makers use

several brands of low silicon pig iron in the charge as they claim a better product results, although if the proper pig iron is purchased from a reputable maker it should not be necessary. In some foundries as much as 25 per cent charcoal pig iron is used in the mixture. Steel also is used often to aid in lowering the silicon and carbon content. This addition will run from 5 to 10 per cent. Ferromanganese is added to the ladle of iron in quantities from ½ to 3 pounds, pea size, to add strength and assist in sulphur removal.

One suggested mixture for mine car wheels consists of 30 per cent malleable bessemer pig iron, containing 1.60 per cent silicon; 25 per cent charcoal pig iron, containing 1.0 per cent silicon; 35 per cent return mine wheel scrap, and 10 per cent steel scrap. About 3 pounds of pea size ferromanganese added in the ladle per 100 pounds of iron will be necessary to bring the manganese to around 0.60 per cent in the casting.

Q & A

Casting Resists Heat

QUESTION

We would like to know what is the best mixture for making trays to be used in annealing tinplate. These castings must withstand heat.

ANSWER

Heat resisting castings such as you mention generally are made from alloy steels in this country. These steels will contain varying amounts of chromium and nickel, and in many cases are patented materials. White cast iron would be a good material for this purpose if it were not quite so brittle. Therefore, you will have to modify the mixture used so as to obtain a mottled structure midway between white and gray irons. The amount of silicon in your mixture will be based on the thickness of your castings. If the castings are around 1-inch thick the silicon may run around 1.50 per cent. If they are thinner, the silicon will have to be increased until the desired structure is obtained.

Some firms are using alloy additions to obtain better heat resisting qualities. One mixture given for this purpose is composed of 10 per cent malleable pig iron containing 2 per cent silicon; 80 per cent steel scrap, and 10 per cent chilled car wheel scrap. To this mixture 1 per cent nickel and 0.50 per cent chromium are added. The resulting analysis is given as 1.10 per cent silicon; 0.95 per cent nickel and 0.50 per cent chromium. Due to the use of malleable pig and steel scrap, the phosphorus will not be over 0.25 per cent. If this mixture is too hard for your purpose, increase the silicon to 1.50 per cent.

GENERAL

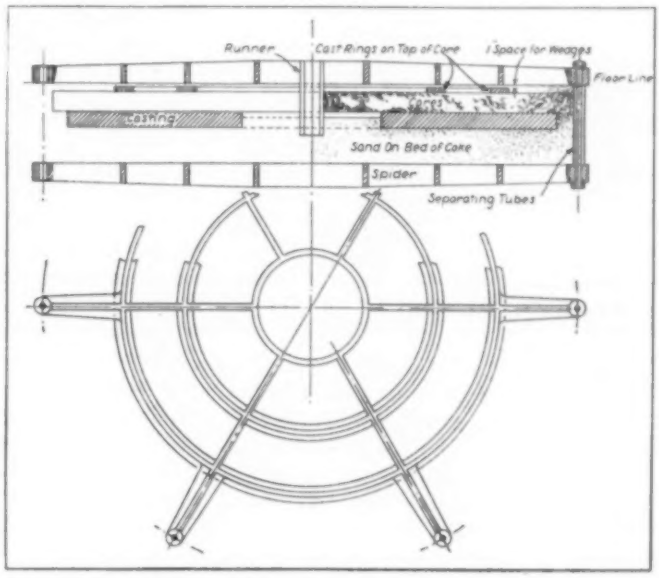
Spider Is Too Light

QUESTION

We are preparing to make some castings 14 feet diameter, 5½ inches thick with a 4-foot opening in the center. We propose to sweep the mold in the floor, skin dry it and cover it with a core made in 18 sections. The point of each core will rest on the island in the center of the mold and the outer end will rest on the outer wall of the mold. We are enclosing a sketch of the rigging we propose to use and shall be glad to have any criticism or advice you may care to offer.

ANSWER

The rigging shown on the sketch accompanying your letter is open to several objections. It is too light, it is not as efficient as a pair of plain plates, it is expensive to build and will consume considerable time in its application. Bolt lugs are too far apart for safety on the outer circumference. Additional lugs are required on the inside. A pressure of approximately 35 tons is exerted against the lower cores. Cores and spider or even a plate will spring in the center unless several bolts are provided similar to those on the outside.



THE PRINCIPAL OBJECTION TO THIS METHOD OF BINDING A MOLD FOR A LARGE CIRCULAR PLATE IS THAT NO PROVISION HAS BEEN MADE TO PREVENT THE CENTER FROM SPRINGING

Covering cores will vary slightly in thickness, therefore your rings will not rest on all uniformly. The low cores will rise under pressure and as a result the face of the casting on the cope side will not be even.

You can get clear of all the elaborate rigging and simplify the job to a considerable extent by casting two plain circular plates 2 inches thick, 15 feet in diameter outside with a 3-foot diameter opening in the center, with 12 bolt lugs on the outer edge and 6 on the inner edge.

After the covering cores are placed they are covered with about 1 inch of green sand and the upper plate is rubbed down to a bearing. Then the bolts are tightened to secure the plate properly and the job is done.

However—this of course is a suggestion which may not be applicable to this particular casting—if only one side of the casting is to be used in service, why not pour the iron in an open sand mold? So far as service is concerned the casting will be just as satisfactory as one poured under a cope and your molding cost will be reduced more than half. All the risk of dirt, strains and runouts will be eliminated.

Q & A

Cores Made in Oil Sand

QUESTION

I am having some trouble with gasoline engine cylinders. The jacket core is made from white sand from the Ottawa district. The sand is bonded with linseed oil but the cores do not work satisfactorily. Is it necessary to use wax vents in these cores?

ANSWER

The sand, to which you refer, bonded with linseed oil or with any of the core oils on the market is used extensively for the jacket cores of gasoline engines. The use of wax vents is optional and depends to a considerable extent on the shape and size of the core. In the smaller sizes no vents are required. The cause of your trouble may lie in the relative amounts of sand and oil in the mixture, the manner in which the sand is mixed and the time and temperature at which the cores are dried.

The ideal amount of core binder to use is just sufficient to hold the core in shape until it has been surrounded with iron. Naturally this amount will vary with cores of different

shapes and sizes. The average ratio of linseed oil to sharp sand is 1 to 50, but the correct ratio for any given core must be worked out by experiment. The idea of holding the amount of binder down to a minimum, primarily is to reduce the volume of gas which is generated when the molten metal comes in contact with the core. Of course, economy also is a factor, but it is only of a secondary character. The best conditions are secured where the oil is added to dried sand and where sufficient water is added afterward to render the sand workable. Oil sand cores should be dried in a *hot* oven (approximately 400 degrees Fahr.) and allowed to remain in the oven until they are brought almost to the point of scorching. The idea is to volatilize all the oil possible short of actually destroying the bond.

Q & A

Sand Cause of Leaks

QUESTION

Under separate cover I am mailing two pieces of scrap radiator sections. We are having considerable trouble with castings that show the same general characteristics and will appreciate your opinion on the probable cause. We employ skimmer gates, all good strong facing sand and pour hot iron into the molds.

ANSWER

From the surface appearance on the cope side of the samples submitted it is apparent that the metal set up a more or less violent commotion when it came into contact with the sand. This condition in the sand may be due to extra dampness, hard ramming or the presence of an abnormal amount of binder. In ordinary foundry language the sand probably is too *tight*. A close checkup will disclose which feature is responsible. The greatest care in every step of the operations involved in making the mold and the greatest uniformity in the condition of the sand, are essential in making such tricky castings as radiator sections. From the fact that the skin on the drag side of the samples submitted, is smooth and unruffled, we are inclined to the opinion that either the copes are rammed a little too hard, or that the molders are working the sand on the cope side a little wet, to insure a good *lift*. Too much new sand in the mixture will cause the metal to flutter slightly. These castings are so thin that the slightest flutter is caught and frozen into place almost instantly. This fluttering or boiling action also is responsible for the cold shut streaks that show in places. The flow of the stream is impeded momentarily and a film forms along the edge which prevents it from uniting with the adjoining surface. Cut down on the amount of new sand in the cope. Work the sand a little drier than the sand in the drag. Ease up on the ramming and see that the steam formed in the cope has a chance to escape.

STEEL

Desires Steel Data

QUESTION

I am interested in the manufacture of light steel castings to take the place of malleable castings in agricultural machinery. Most of the castings will weigh about 2 pounds although some will run as high as 8 pounds. Can you give me any data on the most economical method of melting? I might say that I prefer the electric furnace. I do not care so much about the first coat, but after being equipped, I must produce my castings as economically as possible. My estimated production will be from 1 to 5 tons daily. What size electric furnace would be required for that production?

ANSWER

The best way we know to obtain an idea of the difference in cost between the two metals is to get several of the castings you contemplate making, and have some progressive malleable and electric steel foundries give estimates on the probable cost. That will give you a good idea of the relative costs.

If you wish to use an electric furnace, there are two types for the purpose—the acid and the basic. Sulphur and phosphorus cannot be removed in the acid furnace, therefore, the scrap purchased has to be low in these elements. The basic furnace may be used with any kind of scrap within reason—remembering that you cannot make a silk purse from a sow's ear. Each type of furnace has its advocates.

Most electric furnaces will melt charges a little larger than their rated capacities. The first heat melted will take considerably longer than the others as a certain amount of heat is absorbed by the cold furnace. After the first heat, the melting time will be around an hour depending upon the operator and condition of the metal. Several steel foundries melt 6 heats in a 9-hour day. For your estimated production, we suggest a 1-ton furnace based on the maximum of 5 tons per day. It is possible that a 1000-pound furnace might produce that much per day by building up the doors, but it is better to get a larger furnace.

Since the electric furnace manufacturers will have considerable data on hand relating to the performances of their furnaces, we suggest that you get in touch with them. The names and addresses will be found in the advertising section of THE FOUNDRY. We also suggest that you get Larry J. Barton's book, "Refining Metals Electrically" as he gives much information on selecting the size of furnace; power costs, supervision, etc., and the operation of the furnace in melting and refining steel and gray iron. This may be obtained from the book department of THE FOUNDRY.

MALLEABLE

Hard Iron Shows Cracks

QUESTION

We have considerable trouble due to hard iron cracking, and although we have tried various suggestions we do not seem to be able to eliminate this defect. Some of the cracks are so fine that they are unnoticeable until the castings have been annealed. The cracks occur in heavy and light castings and in heavy and light sections. We take every precaution possible in dumping the molds, and the castings are not dumped until the molder has poured off his entire floor.

We recently changed from hand firing to pulverized coal firing on our melting furnaces and we also increased the use of malleable scrap. Our total charge now runs about 30 per cent pig iron, 50 per cent sprue and 20 per cent railroad malleable scrap. Some foundrymen have contended that excessive use of malleable scrap is causing our cracks, but we disagree, as we had the cracks before we used a large amount of malleable scrap.

Our average analysis for the past three months has been: Silicon, 0.90 per cent; sulphur, 0.075 per cent; phosphorus, 0.160 per cent, and manganese, 0.32 per cent. The annealed castings show a wonderful fracture and the physical tests average 55,000 pounds per square inch tensile and 15 per cent elongation.

ANSWER

Your question is incapable of a specific reply and best can be solved by an expert who will come into your plant and make a careful study of all factors entering into production problems associated with the malleable industry. Possible causes of cracked castings are oxidized heats in which considerable silicon, carbon and manganese have been lost in melting, low carbon metal, close or wet molding sands, improper gating, and high pouring temperature. Other causes may be hard cores, although this is not likely as you describe cracks rather than a tearing of the castings or blows; improper arrangement of the cope bars, if any, and occasionally the design of a specific casting. In general the fault is more likely to lie in molding methods or labor conditions rather than in the metal though this is not invariably true.

Problems in Nonferrous Founding

By Charles Vickers

Changes Metal Mixture

We would like a mixture for a bronze to stand high steam pressures, such as for boiler plugs for locomotives. We have been using copper 85; *tin* 5; *zinc* 5 *and lead* 5 *per cent. Is this a good mixture for steam castings? If it is, should it first be ingoted, then the ingots be remelted for the castings? In what order should the metals be added? In looking through the Foundryman's Handbook we note that many of the mixtures call for an ounce or two of phosphor-copper per hundred pounds of metal. Wouldn't phosphor-tin do just as well? If not, why not? The bronze we use for our pumps consists of* 87 *per cent copper,* 7 *per cent phosphor-tin, and* 6 *per cent block tin. We melt the copper first and add the block tin, and then pour into pigs. We then remelt these pigs and pull the pot, then add the phosphor-tin, stir the metal good with an iron bar and then pour the molds. We get good steam castings when handling the metal in this way. Is this the correct way? Should charcoal be put into the pot with the copper, or should the copper be allowed to start to melt before it is covered? Should brass or bronze be poured hot, or just hot enough to run the castings? Some founders claim that pouring good and hot gives sound castings, while others believe in cool pouring. Which is correct?*

Ounce metal or 85, three fives as it is more often now known always has been used for common steam brass goods, but it will not withstand high steam pressures. For such castings as steam boiler plugs it has been used extensively. It is an old alloy and it got its name of ounce metal from the fact that one ounce each of tin, lead and zinc were added to each pound of copper. It is the original 16 to 1. It usually is modified now, first in the interests of economy, and next because it was discovered that the modified alloy was just as good as the original. The modified alloy consists of 5 per cent copper; 4 per cent tin; 5 per cent lead, and 6 per cent zinc. If experience has shown that the ounce metal can be improved upon we suggest substituting the old standard valve alloy; 87 per cent copper; 7 per cent tin; 3 per cent lead; and 3 per cent zinc. It is not considered necessary to first ingot the alloy, then remelt the ingots for castings. However, this practice will improve the alloy greatly provided the first melt is deoxidized with a small quantity of manganese. Then, deoxidize the remelt with phosphorus. When a deoxidizer is used and is first added to the molten copper, it makes no difference in which order the white metals are added, as far as we have been able to determine from tensile tests. The manganese-phosphorus additions as outlined however do make a great difference.

Phosphor-copper contains around 15 per cent phosphorus, which roughly is 3 times the content of phosphor-tin. If 2 ounces of phosphor copper are suggested this would be 6 ounces of phosphor-tin of 5 per cent phosphorus content. The result would theoretically be the same, but as the 6 ounces of tin would raise the content of that metal in the bronze, better results would be obtained with the phosphor-tin than with the phosphor copper, unless, of course, an allowance is made for the tin.

The method of making the bronze for pumps is a good one as the metal then is alloyed thoroughly, and is deoxidized on the final melt. It is more costly though and for that reason it not generally practiced. We suggest the practice be continued for important work, as we can see no objection to the procedure. Probably the extra melting cost is saved several times over, by getting better metal, and avoiding such troubles as porosity and lack of homogeneity, which would mean leakers.

Charcoal should not be put into the pot with the ingot metal for the simple reason that it takes up room and does no good. In a coke-fired crucible furnace the better practice is to use the bilge part of an old pot on top of the melting crucible to form a hopper so that all the copper can be piled in the pot when the latter is charged then on top of this copper place a small block of hardwood. The latter burns slowly and gives off gases, which remove the oxygen in the atmosphere that might attack the heating copper. This is good practice, and additional blocks can be added whenever it is necessary.

We will not attempt to decide the question as to hot or cool pouring. Personally, we believe in pouring sufficiently hot so that the metal will be completely liquid. If pouring is done when the metal has cooled thick and mushy, the castings will be no good, in our opinion. In any case get the metal hot in the furnace, and hot means not under 2250 degrees Fahr., for most brasswork. Then it can be cooled to suit, remembering that no one has yet succeeded in pouring sand molds with solid metal, and that as time passes the liquidity of the brass constantly decreases as it cools.

Q & A

Use Magnesium Alloy

We would like to learn of an aluminum alloy suitable for making casting for airplanes, that will possess a greater strength than the alloy of aluminum with 8 *per cent copper, but which will not weigh any more. Would a mixture of magnesium with the* 92 *aluminum,* 8 *copper alloy give us these results, and if so, what would the percentages be?*

Use an alloy of 95.75 per cent aluminum; 2.5 per cent copper; 1.25 per cent iron, and 0.25 per cent magnesium. To get these proportions correctly the analysis of the virgin aluminum ingot should be known. Therefore it would be advisable to have an analysis made, even though one is given with the material. A mixture of 92 per cent aluminum, 8 per cent copper, to which magnesium is added would not be satisfactory. Alloys of aluminum and magnesium are not used much, due to the difficulties encountered in making castings. An alloy of 7 per cent magnesium with 93 per cent aluminum is a strong and tough alloy, but percentage of defectives may be high.

Bill Reads a Story About a Foundry

By Pat Dwyer

ONE passage in the *Old Testament* always comes to mind when I hear a man extolling the present era as the greatest in the history of man. The speaker may have done absolutely nothing to push the good work along. Through circumstances over which he had no control, he happens to be here. Because wonderful things are going on, he calmly assumes that he is entitled to a full per capita share of the credit. I suppose it is a harmless form of egotism. Since we all are afflicted with the disease to a greater or less degree, no person thinks of pointing the well known finger of scorn, or of throwing a healthy sized brick at the glass inclosure.

One of the most familiar examples of this distorted form of thinking is found among city dwellers, particularly those who drift in from smaller communities. Over night they develop a civic pride far in excess of that shown by the native sons. They brag about everything, churches, schools, stores, theaters, parks, banks, streets, the number of automobiles, number of railroads, bank clearings, everything that goes to make up a populous and wealthy city as if they had a personal and financial interest in them. A lad making $25 a week and living with a wife and family in two rooms, will rig a bed for a vistor on two chairs and keep him awake for two hours telling him of the immense factories, the tall buildings, the night clubs, the luxurious stores in the main street, the fabulous wealth and magnificent residences of the great captains of industry and other marvels of OUR city. It is all kind of pitiful and pathetic, and as I said in the beginning, reminds me of a passage in the *Old Testament*. A passage which shows that the average man has not progressed much in his manner of thinking. At a pinch you probably could dig up hundreds of references to prove this point and then again, maybe I am overestimating your powers of memory.

However, I am sure that a hint is all that is required. When I mention the *Book of Proverbs* you will commence to get warm. Reference to the thirtieth chapter will set you right on the trail and when I intimate that the verses are—now guess!—18 and 19, you will snap your fingers. The words stand out as clear in your mind as they did 40 years ago when you and your young brother stumbled over them for the first time in Sunday school. When, like a parrot, you had to memorize them without the least conception of their meaning.

There be three things which are wonderful to me. Yea, four, which I know not.

The way of an eagle in the air, the way of a serpent upon a rock; the way of a ship in the midst of the sea and the way of a man with a maid.

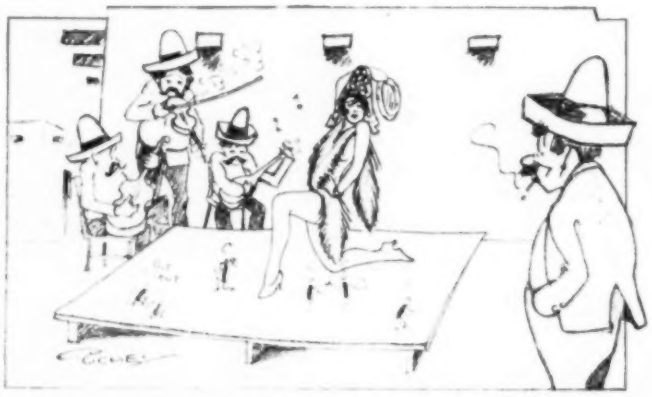
These four things were beyond the comprehension of the worthy old writer of the *Book of Proverbs*. Despite the wonderful advances of the human race the arts and sciences, they still a -as the boys say—over our heads—like the birds!

A comparatively small number of men profess some knowledge of the way of a ship in the midst of the sea. A lesser number has essayed imitation of the eagle, but up to the present no man can predict which direction a snake will slither across a rock. The idiosyncrasies of a love sick swain always have and always will excite the amazement and sometimes the good natured ridicule of the three great classes into which mankind is divided: Those who are too young to be afflicted, those who have recovered, and those who are suffering from the malady, but who fondly imagine that their condition is secret.

Instead of forging bravely ahead, upward and onward and so forth, I greatly fear we are slipping in some respects. If the ancient writer was to come back today, I am sure he would add one more to his list of profound mysteries. With his diction brought right up to date he probably would write:

And one more thing has got me stopped. How do these here now movie directors get that way?

He would be referring of course to the fearful and wonderful manner in which dialect stories or stories in which the scene is laid in a foreign country, are presented by stars of greater and lesser magnitude on the silver screen. Even the veriest moron knows that people in these countries have their own language in which to express their thoughts with fluency, accuracy and within the nicest grammatical limits. Naturally these languages are translatable into English with like characteristics. Every person knows this, except the director. His process of reasoning seems to be similar to that of the colored preacher of whom one of his adherents said: "Reverend Brown am one hot diggity dog preachah. He am de only one I evah hea'd who kin unscrew de unscrutable!" In a recent



A CROSS BETWEEN THE BOLERO AND THE HIGHLAND FLING

talking picture of this kind, the hero, in the first act betrays a slight accent and is addicted to the frequent use of *amigo* and *adios*. That is perfectly all right you decide after you learn that he is the grandson and therefore the rightful heir to a haughty don, master of a wide spread and magnificent rancho somewhere in the adjoining republic of Mexico.

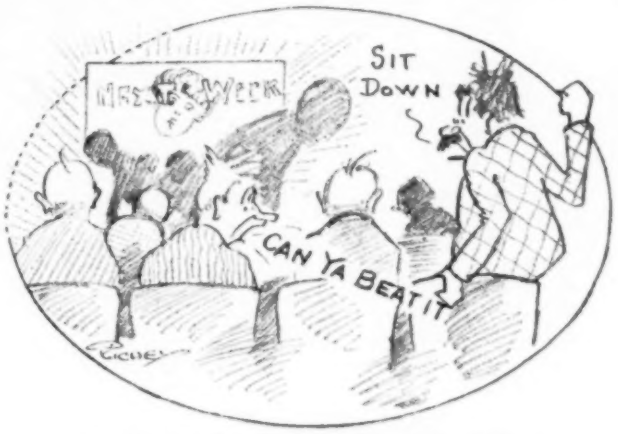
Considering the fact that his mother eloped with an American and that the boy was born and brought up in the United States and that he was graduated from an American university as an engineer, one might be pardoned for wondering how he came by his accent. Probably it was due to the same cause that left him in possession of his only two Spanish words, amigo and adios. A chain of fortuitous circumstances, entirely against his inclination, brings him back to the grandfather's rancho, where the villain, the dirty dog, tries to discredit him and beat him out of his inheritance and his chance of winning the beautiful senorita. The rancho, a magnificent and self-contained principality, as his grandfather is at pains to point out, has been in existence for 400 years. The grandfather and the villain are educated gentlemen who speak English fluently with only two trifling exceptions. They balk at *friend* and *goodbye*. They have to depend on the old reliables *amigo* and *adios*.

In this great Spanish rancho, maintained by the same family in feudal style, with all the traditions and customs of 400 years, it is only natural to assume that Spanish is the prevailing and only language employed. Apparently the director of the picture decided that the proper atmosphere would be lost if the conversation was translated into equivalent English. By a single magical wave of the hand, all the inhabitants of the hacienda, the multitude of servants and the vaqueros who tend the vast herds of cattle, converse in broken English!

In the kitchen, in the grand hall, in the grounds and stables, out on the open range with no English speaking person within probably 500 miles, these misguided people, calmly abandon the mother tongue in which they were born and which presumably they have spoken exclusively up to that time, and carry on all their conversation with each other in fragments of an alien tongue. Simply marvelous, and that is all you can say about it.

At a rural fiesta, the heroine, a beautiful and high born senorita, takes the stage to present a solo dance. Spanish is her native tongue. Spanish is the native and presumably only language spoken by the local musicians. Before commencing, the lady graciously bows to the orchestra leader and asks him to favor her with a certain number.

The Spanish language, as every one knows, abounds in felicitous and flowery phrases. It is particularly adapted to the use of a kindly, courteous, people, sticklers for point of etiquet and all the little niceties of a polished civilization. The director in his omnipotent wisdom boiled the lady's request down to: "You geeve it to me, a little good moosic, no?"



YO-HO-HO! SHIPS THAT PASS IN THE NIGHT

One night recently in the course of a rather desultory conversation, I asked Bill if he had any explanation to offer for this peculiarly perverted attitude on the part of these gentlemen who arrange our amusement features.

"Some of them there birds," this honest yeoman remarked, "give me a pain in the wish bone. How they ever get by with some of the stuff they pull, is one of the seven wonders of this modern world. The other six are represented by you and me and the rest of us who flock to see their work and never enter a protest. We buy a couple of tickets for ourself and the Missus, fight our way into a theater, and then stand in a jam at the back for half an hour until a haughty usher holds up two fingers and conducts us to two singles, 40 feet apart. A constant procession of fat men and squashy women tramp over our feet and succeed in shutting off approximately 45 per cent of the picture.

"However, these super dynamic movie picture impressarios are not the only boys who do funny things, say funny things or write a mess of tripe. Every once in a while a gallant reporter breaks into print with a story about a foundry. He dashes into a shop, collects a few hurried impressions and then rushes back to his trusty typewriter where he pounds out a treatise on the art of founding in metals.

"A man who has spent his entire life in the foundry would hesitate if he was asked to describe how castings are made. The subject is so vast and complex and presents such an infinity of detail that he would shirk from the task. The reporter is not burdened with any silly qualms. In his supreme confidence he feels that foundrymen are rather a dumb lot. No gift for expression, he will tell you airily. Also they are too close to the forest to see the trees. He has the detached outside viewpoint. With his trained reportorial eye he can take a quick look around and unerringly pick out all the salient features. The same old gimlet eye records everything he sees on the sensitized plate of his memory. The only flaw in his line of reasoning is that things are not always what they seem at first sight. I came across one of these gems the other day. Here," Bill continued, pulling a newspaper out of his pocket, "curl your ear around a few gems taken from his description of the opening of a new foundry."

The first step in the process of casting is to duplicate the pattern in a special metal, chosen by foundrymen for its imperviousness to heat or cold and atmospheric conditions generally. That is to say, this special metal contracts and expands less under varying temperatures than do other metals that might be used for the purpose. It is with this metal pattern that the molding is done. A series of these metal patterns are formed or "ganged" together.

"Some pattern!" Bill remarked. "Impervious to heat, cold and atmospheric conditions generally." He continued to read and comment:

Each molder has his bench and tools placed at some well lighted and convenient point along the sides of the glass walled foundry (Like swallow's nests, hey?) When he has been given a pattern to cast, he studies its peculiarities to see what particular degree of artfulness it calls for in the casting. Actually, he glances at it (Actually, mind you) and his practiced eye combining with his years of experience, dictates to his instincts what care he must exercise. what tricks from his bagful (Tricky lads, these molders) must be brought into play.

The molder places on his bench a little platform of rough wood. On this platform he puts a frame of

iron. It circumscribes an area about the same as the platform and is 4 or 5 inches deep or high (Depth and height mean the same thing). Two perforated lips project a short way from the upper edges (Up, down or sideways?). These are part of the registration mechanism, the means by which the upper half of the mold will be held in exact juxtaposition to the lower (Apparently he is referring to the cope).

Into this frame the molder tosses some moistened sand, a very special sand with a clay content negligibly low. Carefully he sifts it down so that it becomes a compact mass in which there can be no unseen pockets that will crumble later in the process (Unseen pockets always crumble). Then he imbeds in the sand the metal pattern given him, imbeds it so that just half of it lies below the level of the top edge of the frame mentioned, and half above (That is where he needs most of the tricks in the bag). He proceeds from this point to completely fill the frame with his molder's sand, tamping it in the while carefully about the pattern so that it fills every crevice and conforms snugly to every surface. Herein lies the first trick in the molder's bagful.

"The next trick he pulls out of the bag," Bill grinned, "is a real trick. Listen."

Half the mold is now complete. The frame he uses for the second, or upper half (He started a few minutes ago with the cope) is like the first except that the lips projecting from the shoulders are not perforated, but have round pins sticking from them (Sticking is good) and that fit into the holes in the lips of the under frame.

"Stand by now," said Bill. "Here comes the trickiest trick in the bag."

Having lifted the pattern from the first mold, the worker sets that completed sand model aside and prepares the upper part of the pattern in a manner similar to the first. Then he fits the upper and lower sand laden frames tightly together on the little platform (Thurston himself could not beat that).

The iron is prepared (Get that, prepared) in a big cupola at the west end of the big foundry. The writer saw it decant (Ha, ha!) between six and seven tons of liquid metal in a few minutes (How times flies) one afternoon this week.

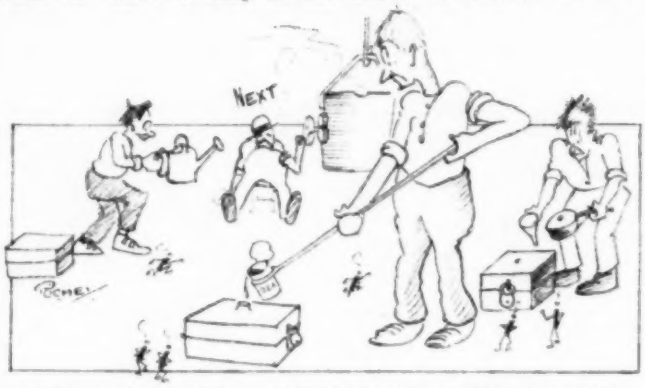
"The following important item of general information is just tossed in nonchalantly for good measure":

Unlike the process of converting iron to steel, that of producing iron for casting takes only 6 to 8 minutes, once the cupola has been loaded with the pigs or iron briquets. The cupola is like a big bowl, from which one may get as many as four kinds of soup.

"Nothing escaped the old eagle eye. Listen to how these tricky molders carried the iron in hand ladles resting in hoops stuck on wooden shanks."

Now an iron framework is set under the trough and on it is balanced the 500-pound ladle that will receive the iron as it flows from the cupola. This ladle, a big metal bucket, has an iron rod projecting from either side and terminating in a pair of handles like those on a bicycle. The ladle swings free, the rods resting on the supporting framework. A workman, grasping the handles at the end of the rod, tilts the ladle at will (No coercion, just whenever he feels like it).

Down the trough gushes the molten iron as the melter opens the cupola vent (Much more refined term than the vulgar tap hole). The ladle fills and the vent is closed. Meanwhile the molders have assembled about the trough, each carrying a small ladle in a hoop at the end of a wooden staff (You'll go a long way, before you'll find a neater and more accurate description of a hand ladle shank than that—a hoop at the end of a stick!).



INTERESTING ITEMS FROM THE MOLDER'S BAG OF TRICKS

A moulder pushes his small ladle up under the big ladle and a stream of iron fills the molder's instrument (with the wooden handle). Arriving at his molds (I wish he would stick to one form of spelling) and tipping the pot at the end of his stick, he smoothly and carefully pours molten iron down little funnels in the sand. A steady hand is required. Having filled as many moulds as he can from his ladle before the cooling of the metal in the pot at the end of the stick's end has progressed to a point where it would endanger the casting to attempt to pour more or where there is not enough molten metal left to completely fill another mold, the moulder rushes back to the big ladle below the cupola trough to have his ladle filled again and again.

"After performing all these prodigies," Bill interrupted at this point, "you will not be surprised to learn that":

The molder is damp with sweat, probably a bit out of breath. The foundry is thick with acrid smoke and the big ladle by the cupola has been filled many times and tipped its contents into many moulder's ladles before the run is ended. The moulder does not pause for breath at this stage of the game (Just takes a few gasps on the run). The first molds he filled are now cool enough so that the iron in them has solidified. With an iron hook he scurries between their ranks, catching them by their wooden platform bases and upsetting them.

"Accounts of that kind," Bill remarked, "remind me of the time Tony Mombretti attended a spiritualistic seance in New York. The medium told him she could put him in touch with his brother in Milan, Italy. Presently a voice out of the darkness said, 'Hello, Tony, this is your brother Luigi. Is there any question you would like to ask me?'

"'Yes,' says brave Tony, 'I should lika to know, since when you learna to spika da Angleesh so good!'"

Study Manganese Effect

Three factors which essentially determine the modifying effects of manganese on carbides in the iron-carbide system are as follows: Manganese tends to enlarge the temperature range of stability of gamma iron or austenite; manganese forms a carbide that is more stable than cementite; and manganese atoms hardly can diffuse at all through the iron space lattice at ordinary heat-treating temperatures at which carbon atoms diffuse quite freely. In steels containing more than 1 per cent manganese, dendritic segregation causes a marked dendritic pattern on cast sections from metal or sand mold and a fibrous pattern in rolled or forged bars, manganese being higher in the dendrite filling. These patterns appear to be removed by heating for 1 hour at 1300 degrees Cent. These data are taken from Technical paper No. 466 on "Effect of Manganese on Distribution of Carbon in Steel" which recently was issued by the bureau of mines. Copies of this paper may be obtained from the superintendent of documents, Washington, for 20 cents.

Opens New Office

Chicago Pneumatic Tool Co., 6 East Forty-fourth street, New York, has opened a branch office at 327 Philcade building, Tulsa, Okla. George J. Lynch has been appointed district manager in charge of that office which will hande the sales and servicing of the products manufactured by the company. The office recently opened at 1 West Sixteenth street, Oklahoma City, Okla., to handle special machinery, will continue to operate.

Paul Maehler Co., Chicago, manufacturer of industrial ovens, recently held a sales conference at the Midwest Athletic club, Chicago. Among the feature events of the meeting was the dedication of the new company office building which recently was completed.

The FOUNDRY Family Photograph Album

Upper Left

W. J. LANGSTON

Canada Iron Foundries Ltd., Montreal

Upper Right

M. F. BARRETT

Cleveland Brass Mfg. Co., Cleveland

Lower Left

J. T. OSLER

Hubbard Steel Foundry Co., East Chicago, Ind.

Lower Right

L. H. HEYL

Federal Foundry Supply Co., Cleveland

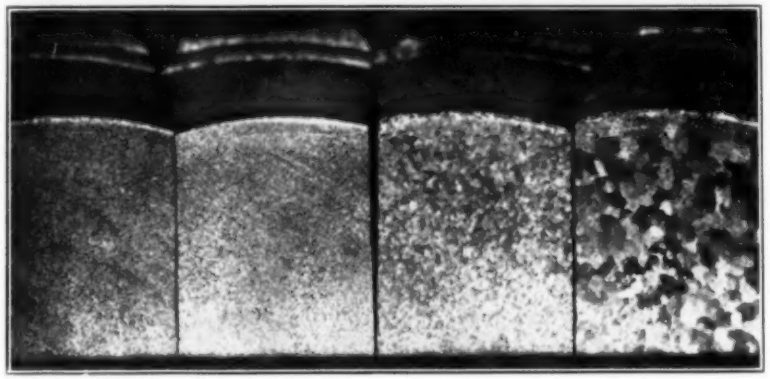
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

NEED ALUMINUM TEMPERATURE CONTROL

(*Continued from Data Sheet No.* 804)

temperature 20 degrees Fahr. higher than the lower temperature at which the casting could be poured may be considered a safe working temperature, the addition of 20 degrees Fahr. being sufficient to take care of any irregularities in the temper of the sand or in the rate of pouring.

However, pouring the casting at the correct temperature does not assure necessarily a sound casting; the damage may have been done in the melting operation. Overheating the metal or holding it at an elevated temperature for any appreciable length of time will cause a coarse grain



1320°F. 1400°F. 1500°F. 1700°F.

FIG. 3—THE EFFECT OF MELTING TEMPERATURE ON THE GRAIN SIZE OF NO. 12 ALLOY CASTINGS. THE METAL WAS HEATED TO THE TEMPERATURES INDICATED, AND ALL WERE POURED AT 1320 DEGREES FAHR. (T. W. BOSSERT)

structure in the resulting casting even though it be poured at the proper temperature. The melting temperature must be controlled also, and this temperature should be held as near the pouring temperature as is consistent with operating conditions. The ideal temperature would be the same as the pouring temperature; and while this ideal can not be reached at all times, some foundries are approaching it by placing holding furnaces in close proximity to the molds.

In case delays occur in the foundry, it is essential that the temperature of the molten metal be watched. While metal held at a low temperature will not be injured as seriously as metal held at an elevated temperature,

(*Concluded on Data Sheet No.* 806)

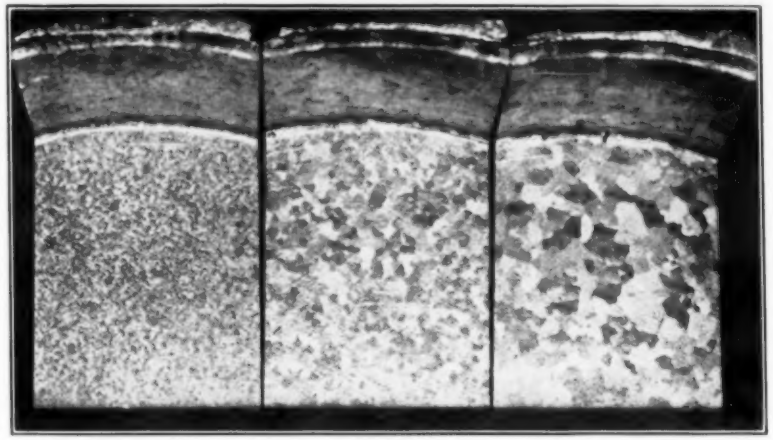
NEED ALUMINUM TEMPERATURE CONTROL

(*Concluded from Data Sheet No.* 805)

it is best in case of extremely long delays to hold the metal at a temperature just below the melting point of the alloy.

Metal which has been injured by overheating can be reclaimed by pigging and remelting to the correct temperature. A second pigging and remelting may be necessary if the metal is burned badly, and even then the harmful effect of burning may not be lost completely.

Too much can not be said for the proper pyrometric control in an aluminum foundry as the soundness and strength of the castings depend



0 HOURS 4 HOURS 24 HOURS

FIG. 4—THE EFFECT OF SOAKING NO. 12 ALLOY AT 1450 DEGREES FAHR. THE CASTINGS WERE POURED AT THAT TEMPERATURE AFTER THE METAL HAD BEEN HELD THE INDICATED LENGTH OF TIME. (T. W. BOSSERT)

to a large extent upon the melting and pouring temperatures of the metal. An efficient temperature control is the foundation upon which all aluminum foundry technique is based, but it does not mean necessarily that an efficient temperature control is a cure-all for all foundry troubles. The soundness of a casting depends upon many factors: the method of gating; the application of chills; the texture, permeability and hardness of cores; the texture, temper, permeability and cohesiveness of molding sand; and the method of pouring; as well as upon the pouring temperature and practice employed in melting.

CLEVELAND *Prepares for* Visiting Foundrymen

PLANS for the annual convention and exhibition of the American Foundrymen's association, to be held in Cleveland's public auditorium, May 12 to 16, are being completed rapidly. The technical sessions, at which papers will be presented by many leaders in the industry, both in America and abroad, will offer an exceptional opportunity for foundrymen to learn of the latest developments which have been made in the art of casting metals. Round table discussions and shop operation courses for the nonferrous, steel, malleable and gray iron branches will offer a vehicle for the interchange of practical solutions to many foundry problems.

The exhibition of foundry and machine shop equipment and supplies will be one of the largest in the history of the association. Space reservations to date, according to a report of C. E. Hoyt, executive secretary of the American Foundrymen's association, are far in excess of the total floor space used at the Cleveland convention in 1923, when the exhibit also was held in the public auditorium. The large arena in the auditorium and the entire exhibition hall will be filled with equipment and supplies of the latest types. In addition, the closed corridor connecting the auditorium and the exhibition hall will house various educational displays prepared by the American Foundrymen's association.

Entertainment for visiting foundrymen will be provided by Cleveland foundrymen and equipment and supply manufacturers. Committees have been organized to handle the details connected with the entertainment features and definite plans will be announced in the near future. The Clevelanders serving on the various committees are as follows:

Executive Committee—Walter L. Seelbach, Forest City-Walworth Run Foundries Co., general chairman; Ralph H. West, West Steel Casting Co., vice chairman; Leroy P. Robinson, Werner G. Smith Co.; George Feiss, Superior Foundry Co.; J. S. Smith, Smith Facing & Supply Co.; Dan M. Avey, Penton Publishing Co.; S. C. Vessy, W. W. Sly Mfg. Co.; B. R. Pearse, Atlas Foundry Co.; B. D. Fuller, Whitehead Bros. Co.; J. H. Redhead, Lake City Malleable Co.; Mrs. R. H. West; Frank G. Steinebach, THE FOUNDRY, secretary.

Finance Committee—Leroy P. Robinson, Werner G. Smith Co., chairman; George Feiss, Superior Foundry Co., vice chairman; Homer Tielke, Crucible Steel Casting Co.; W. G. Kranz, National Malleable & Steel Castings Co.; S. C. Vessy, W. W. Sly Mfg. Co.; Dan M. Avey, Penton Publishing Co.; A. D. Norton, Aluminum Co. of America; Franklin G. Smith, Osborn Mfg. Co.

Plant Visitation Committee—J. S. Smith, Smith Facing & Supply Co., chairman; John Francis, Kilby Mfg. Co.; James Mitchell, Cleveland Co-Operative Stove Co.; David Lansdown, West Steel Casting Co.; C. J. Raible, Fanner Mfg. Co.; Fred Ryan, Allyne Ryan Foundry Co.; C. C. Penrose, Ferro Machine & Foundry Co.

Publicity Committee—Dan M. Avey, Penton Publishing Co., chairman; J. D. Wise, Osborn Mfg. Co.; O. D. Conover, Foundry Equipment Co.; F. F. Prentiss, *Iron Age;* Louis Heyl, Federal Foundry Supply Co.

Entertainment Committee—S. C. Vessy, W. W. Sly Mfg. Co., chairman;

Special Reception Subcommittee of the Entertainment Committee—J. H. Redhead, Lake City Malleable Co., chairman; A. J. Tuscany, Gray Iron institute; P. J. Strangward, Forest City-Walworth Run Foundries Co.; Chas. W. Hotchkiss, National Malleable & Steel Castings Co.; R. A. Weaver, Ferro Enamel Supply Co.; D. J. Ryan, Allyne Ryan Foundry Co.; Howard Greenebaum, Acme Foundry, Inc.; A. D. Smith, Jr., Bethlehem Steel Co.; R. E. McMahon, M. A. Hanna Co. Division of National Steel Co.; J. S. McKesson, Corrigan-McKinney Steel Co.; R. S. Fox, Cleveland Cliffs Iron Co.; George Striebing, Pickands, Mather & Co.

Welcoming Subcommittee of the Entertainment Committee—B. R. Pearse, Atlas Foundry Co., chairman; Elmer F Scott, Ohio Foundries, Inc.; T. J. Calhoun, Johnston & Jennings Co.; E. S. Cohen, Stoney Engineering & Foundry Co.; Ralph Ditty, Federal Foundry Supply Co.; D. J. Gluntz, Gluntz Brass Foundry Co.; H. B. Harsch, John Harsch Bronze Foundry; M. W. Merriman, Madison Foundry Co.; J. E. O'Brien, Fanner Mfg. Co.; F. J. Opatrny, Beardsley & Piper Co.; W. J. Strangward, Forest City-Walworth Run Foundries Co.; Charles Seelbach, Forest City-Walworth Run Foundries Co.; H. G. Wellman, Wellman Bronze Co.; W. S. Wellman, Wellman Products Co.; H. H. Schneider, Aluminum Foundry Equipment Co.; C. G. Frantz, Apex Electric Mfg. Co.; A. H. Meyer, Austin Co.; H. L. McKinnon, C. O. Bartlett & Snow Co.; J. H. Shafner, National Bronze & Aluminum Co.; H. H. Barclay, Beryk Co.; J. V. Brost, Brost Pattern Works; Edwin S. Carman, Edwin S. Carman Inc.; M. J. Thomas, City Foundry Co.; C. A. Barnett, Foundry Equipment Co.; A. S. Deutsch, Monarch Aluminum Ware Co.; J. F. Leitch, Ferro Machine & Foundry Co.; A. C. Dennison, Fulton Foundry & Machine Co.; M. C. Rosenfeld, Grabler Mfg. Co.; J. F. Hines, Hines Pattern & Mfg. Co.; R. S. Hoffman, Hoffman Bronze & Aluminum Casting Co.; H. A. Schwartz, National Malleable & Steel Casting Co.; C. M. Bolich, Nickel Plate Foundry Co.; H. R. Street, Parker Street Casting Co.; Harry E. Boughton, Standard Sand & Machine Co.; S. S. Parsons, Steelblast Abrasive Co.; Philip Goehagan, Ohio Foundry Co.; Carl G. Schluederberg, Westinghouse Electric & Mfg. Co.; H. A. Baker, Oiless Core Binder

Co., A. L. Wheeler, Eberhard Mfg. Co.; Werner G. Smith, Werner G. Smith Co.; J. R. Booher, Cleveland Crane & Engineering Co.; J. Luton, Taylor & Boggis Foundry Co.; W. O. Larson, Hill Clutch Machine & Foundry Co.

Golf Subcommittee of the Entertainment Committee—B. D. Fuller, Whitehead Bros. Co., chairman; A. H. Chappelka, Lake City Malleable Co.; M. J. Sweeney, Allyne Ryan Foundry Co.; J. H. Bruce, Bowler Foundry Co.; Robert E. Belt, Malleable Iron Research Institute; Henry J. Trenkamp, Jr., Ohio Foundry Co.

Ladies' Reception Subcommittee of the Entertainment Committee—Mrs. R. H. West, chairman; Mrs. W. C. Sly, Mrs. H. A. Schwartz, Mrs. S. C. Vessy, Mrs. J. D. Wise, Mrs. P. J. Strangward, Mrs. Werner G. Smith, Mrs. John T. Stoney, Mrs. B. R. Pearce, Mrs. B. D. Fuller, Mrs. W. J. Strangward, Mrs. A. C. Dennison, Mrs. Chas. Seelbach, Mrs. H. L. McKinnon, Mrs. M. W. Zeman, Mrs. A. H. Chappelka, Mrs. C. M. Bolich, Mrs. A. J. Tuscany, Mrs. Walter Seelbach, Mrs. Leroy P. Robinson, Mrs. Dan M. Avey.

Steel Founders Discuss Merchandising

WHILE the immediate outlook is somewhat unsettled, an acceleration in activity in the steel casting industry in April and May was predicted by certain leading members at the monthly meeting of the Steel Founders Society of America at the Bellevue-Stratford hotel, Philadelphia, Feb. 26-27. Proposed construction work, expected to get under full swing four or five weeks hence, will add considerable impetus, it was believed; moreover, continued good railway car buying was anticipated, with at least a moderately good year in the machine tool industry. The representative of one large foundry predicted the year's operations at steel casting plants would probably average 75 to 80 per cent. Meanwhile, the situation is spotty, although bookings on the average are fairly good.

Give Meeting Date

Announcement was made that the Society's next semiannual meeting would be held at White Sulphur Springs late in June and that the next monthly meeting would be held in St. Louis, March 27. Sixty were in attendance.

Organization of an alloy section for manufacturers of heat and corrosion resisting castings was undertaken. Of special interest were indications of the early completion of the Society's code of trade customs. Tests on grinding wheel guards have been completed and the data now is before the committee for approval. The Society's revised cost system probably will be reported in about six weeks. This cost system can be applied by all producers of standard work, whether a manufacturer of large or small castings.

Granville P. Rogers, managing director, reported that the Society's 1930 directory of steel foundries will be available in about a month. Figures will be presented on the production of steel castings by type, namely, alloy, carbon, heat and corrosion resisting castings. The first issue of The *Steel Founder*, the official bulletin of the society, will be published early this month.

Discussing merchandising problems, C. Tolan Jr., Dodge Steel Co., Philadelphia, urged manufacturers to talk quality and "to think in terms of selling, not giving." Job costs and job profits, not tonnage is the major consideration, he declared. The speaker also urged an extension of the small group research idea now prevalent. T. S. Quinn, Lebanon Steel Foundry, Lebanon, Pa., outlined factors influencing the design of sand handling equipment in the steel foundry. Another interesting speaker was George Batty, research director, Steel Castings Development bureau, Philadelphia, who spoke informally on the interrelationship of pinhole troubles and low ductility.

C. E. Walsh, purchasing agent, Pennsylvania railroad, outlined various functions and policies of railroad purchasing. The country's largest buyers, the railroads, the speaker declared return fully 25 per cent of their annual combined revenue of more than $6,000,000,000 to industry and mines for the purchase of materials, supplies and fuel. The Pennsylvania railroad alone spends more than $166,000,000 a year for the requirements of its own and subsidiary organizations which comprise something like 100 transportation and other types of companies. It now costs the Pennsylvania railroad less than 60 cents for every $100 worth of purchases, the speaker said.

With the railroads accounting for 25 per cent of the combined purchases of the country, it is to every business man's interest, he said, to see that the earnings and credits of the railroad should not be impaired. Mr. Walsh asserted that the railroads purchase about 16 per cent of the country's production of iron and steel; 18 per cent of fuel oil; 20 per cent of timber consumed, and 25 per cent of the bituminous coal.

W. J. Nugent, formerly president of Nugent Steel Castings Co., recently merged with Sivyer Steel Casting Co., Milwaukee, has resigned as chairman of the statistical committee. He will be succeeded by C. A. McDonald of the latter company. W. J. Griffiths, Commercial Steel Casting Co., Marion, O., has been named as an additional member of the cost committee in recognition of his work in assisting that group.

R. J. Doty, of the technical research committee, declared that the steel foundry industry should do more along the line of acquainting engineers and designers with the rapid strides made in the foundry industry in recent years. Foundries, he asserted, are constantly receiving blue prints designed by engineers with little fundamental knowledge of the casting industry. He stated that it has been proposed to the American Society for Testing Materials that for their June meeting there be organized a symposium to discuss the developments in engineering properties of castings.

Scores Technical Schools

Mr. Doty noted a growing lack of interest and consideration to the casting industry by technical and scientific schools, adding that the society has recently addressed a letter to all technical schools and universities, pointing out the necessity of maintaining in their engineering work a complete course on modern steel foundry practice.

The greater portion of one session was devoted to a discussion of new fields for modern steel castings.

S. B. Taylor, formerly engineer in charge of drafting, Reliance Electric & Mfg. Co., Cleveland, has been appointed assistant works manager. Mr. Taylor became associated with the company in 1925 as design engineer of alternating current motors and was advanced to engineer in charge of drafting in 1928. He is a graduate of Purdue university in electrical engineering.

Cupola Malleable
Is Cast in Permanent Molds

By Harvey W. Hyde

SOME means must be taken to preserve the face of the mold which is in contact with the molten metal and many methods have been tried. The simplest and in many ways the best protection is obtained by smoking the face of the mold with an acetylene flame. This flame is sooty and leaves a film of carbon on the mold that is resistant to the action of the metal. However, the film may be washed off where metal impinges on the mold or at points where considerable metal flows over the mold face before it rises enough to form a shell against the chill. If this action is severe, and the metal too hot, the mold will fuse at these points and be ruined for further use. Such places are affected badly by cracks because the insulation of the carbon is lost and the metal of the mold is overheated locally.

Before starting a day's work, the mold should be heated to about 250 degrees Fahr. This prevents condensation of small amounts of water at the top of the mold and consequent explosions when the first metal is poured. A cold mold can be poured with proper care but it may be dangerous, since the action of any water in the mold will cause metal to be forced out of the pouring basin. The first casting made in a cold mold is seldom good. The mold should be maintained at 250 to 350 degrees Fahr. for good operation. Lower mold temperatures require hotter metal to make a good casting and there is trouble from shrinkage. A cold mold often will cause a cracked casting as the chilling action is so violent that local strains are set up. Operating the molds at a higher temperature will lessen the chilling action below a point that is desirable. It also is hard on the mold as the carbon film does not adhere well to a mold that is too hot and there is danger of fusing the mold to the casting.

It is good practice to remove the casting from the mold as soon as it has solidified enough to stand han-

Study Core Design

PROPER protection of the chill mold surface and correct operating mold and metal temperatures are important factors in producing malleable iron castings in chill molds. Since the cores are not subjected to quite the same conditions as in the sand casting process, more care and study must be devoted to their design and construction. These and other interesting features relating to the application of metal molds to the production of malleable iron castings are discussed in this, the second and concluding article, on the subject.

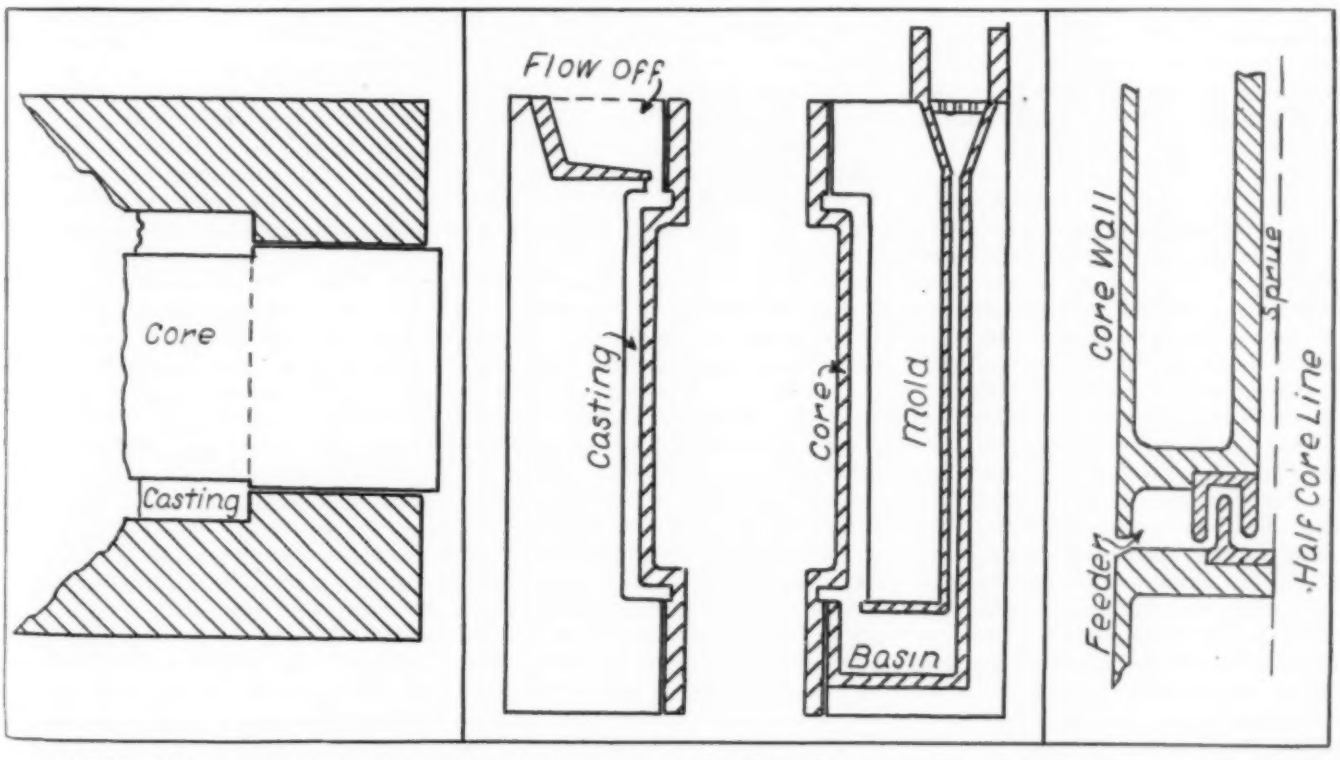


FIG. 2 (LEFT)—SHARP CHANGES IN COOLING RATE CAN BE AVOIDED BY CHANGING THE DESIGN SLIGHTLY. FIG. 3 (CENTER)—A SEPARATE SPRUE CORE AND A FLOWOFF ASSIST IN PRODUCING BETTER RESULTS. FIG. 4 (RIGHT)—METHOD OF ARRANGING THE GATE IN THE BODY CORE. THE SKIM GATE IS SET AS A SEPARATE CORE WHEN THE TWO HALVES ARE PASTED TOGETHER

dling. This is when the piece is at an orange heat. The casting will be soft and ductile at this temperature and must be treated gently or it will be distorted. More loose scale will be formed at this heat than if the casting is left in the mold to cool to a red heat, but no difference can be noted in these castings after they have passed through the remaining operations and are ready for the trade. Leaving pieces in the mold longer than necessary reduces the operating time of the equipment and lessens production, since the absorbed heat in the mold must be dissipated before the mold can be used again safely.

If the molten metal enters the mold through gates in the core, these gates should be removed while the casting is at a red heat. If broken off cold, the gates are likely to gouge into the casting and leave a shallow hole. All gates should be arranged so they will break away from the casting and leave a small amount of metal to be ground off.

Sets the Cores

The number of castings to be made per hour in a mold is determined by the rapidity with which it cools to the proper temperature range. The larger the casting and the thicker the section, the longer the time between castings.

In setting cores, the operator must be sure that they are lined up correctly before closing the mold. As will be shown later, these cores are necessarily fragile and care must be taken to prevent crushing. It is also necessary to guard against loose sand in the mold, which results in an unsightly spot on an otherwise pretty casting.

Cores for use with chill molds must be given close attention. It is of prime importance that they crush easily. A core mixture that gives satisfactory results in sand work may be useless in metal molds and cause cracked castings. The rate and mechanism of cooling of the two methods of manufacture are quite different. In a chill mold, the metal freezes from the mold face to the core about five to eight times as fast as it solidifies from the core toward the chill. This rapid cooling diagrammatically shown in Fig. 5 causes the metal to grip the core suddenly and soon after filling. The core has a short time to be weakened by the burning of the binder and must be soft enough to give readily to the pressure of the contracting casting.

In a sand casting the rates of cooling from the mold and core surface are more nearly equal and there is a longer time for the core to burn out. The contraction of the casting on the core does not occur with the suddenness that is characterized by a chill mold piece and there is less danger of a crack from a hard sand mix. At the temperature at which the contraction of the casting begins, the metal has little cohesive force and cracking will be pronounced if there is resistance to this compressive effect.

The cores should be hollow, with as little wall thickness as will support the metal. Due to the rapidity of cooling, this thickness will be less than would be needed for a sand casting. The cores also should vent readily though this is cared for in most cases by the thinness of the wall. Sand used for the mixture should not fuse easily. Due to the lower pouring temperature of the metal as compared with sand casting, any sand that is

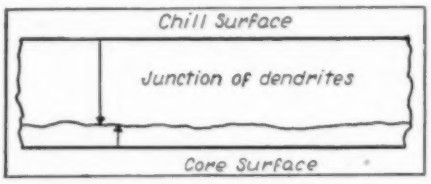


FIG. 5—A DIAGRAMMATIC REPRESENTATION OF THE FREEZING RATES FROM CHILL AND CORE SURFACES

satisfactory for the latter will be suitable. The core should present as smooth a surface as possible, to assist in cleaning operations. It has been found that a small amount of molding sand is advantageous in obtaining this surface as well as easy crushing.

Sufficient binder must be used to prevent washing of the core under the influence of pouring and the baking should be watched carefully to insure that there will be no swelling of the core resulting from the heat of the molten metal.

As far as possible the general contour of the outside of the core should be followed in the inside. Corners should have large fillets as the cores are likely to be broken easily in handling. Heavy sections in the core will cause cracks due to the resistance to contraction of the metal.

While the chill mold is an attempt to correct some of the difficulties of liquid shrinkage in malleable, it does not remove this feature entirely. In portions of the casting where there are heavy sections next to light ones, it may be necessary to place small chills in the core to assist the action of the mold in chilling the metal to a solid mass. This is particularly necessary where machine work is to be done on a heavy portion which is located at a point next to the core.

Small chills of the proper heat capacity either will cause the metal to freeze progressively as it is fed or else move the shrinkage cavity to a point where it will cause no trouble when the casting is machined or where it will not leak under test. Flat chills may be used several times, but those that follow the contour of the casting in such a way that they are gripped during the contraction will be found to be warped out of shape to an extent that prevents their use a second time.

The small chills should be thin enough so that they will heat quickly to a temperature that will let them give easily under compression. The sand next to them must be flush with the surface or metal will grip them at the ends and cause a cracked casting. The smaller they can be made, the less trouble they will cause. The core chills must be clean and kept free from rust to prevent blows in the casting. These blows may not be apparent at the surface but show up after the piece has been machined. Gray iron has proved to be a satisfactory material for these chills.

Causes Cracks

At core prints where mold and core meet at right angles, the core should be expanded to bring the plane of metal in the casting parallel to both core and mold for a short distance as shown in Fig. 2. Wherever there is a sharp change in the contour of a casting next to the core as at an opening in the piece, the edge of this opening should be formed in the core. The reason for this is that when two different cooling states, such as those set up by the mold and the core, come together at an angle, a strain is set up that is too great for the metal to resist and a small crack will result. By bringing this change of cooling rate into the same plane, this strain is removed and no cracks will be formed. Generally, these cracks are small, and if there is any machine work to be done at the point, they will be removed. However, these same cracks are the starting points for larger ones that are found after annealing.

A great deal of work was done on the gating of chill molds in the progress of this work. Some fifty methods were tried. More care must be exercised in gating chill molds than is found necessary with sand casting. The metal must be placed in the mold as quietly and rapidly as possible, and it must be skimmed thoroughly. This skimming is important because of the low temperature of pouring. Feeders are necessary and should be placed as close to the gate

as possible. They should be of ample size to prevent sponginess around the gate. The arrangement of the gate must be such that the metal flows into the mold without any agitation or splashing.

Considerable success has resulted from the use of a flowoff at the top of the mold. This allows the chilling action of the mold to progress while a small amount of metal still is passing through the casting. As the metal rises in this flowoff, the rate of pouring is reduced till the casting freezes in the mold shutting off the passage of metal to the flowoff. This action of progressive freezing serves as an excellent feeder and little trouble is found with shrinkage in the casting.

The ideal gate for this chill mold work is one through which the metal enters the mold at the bottom through an external core held in the mold outside of the main core. It should be arranged similar to Fig. 3 so that a small basin receives the first metal and traps it so that no shot passes into the mold proper. This trap also will act as an effective skim. The gate should be large enough to take the metal rapidly but quietly.

Protects Mold Surface

Pouring from the bottom will protect the mold as the freezing metal will form a channel for the balance of the iron to pass through and only cool, quiet metal comes in contact with the mold. With a flowoff at the top of the mold, a gate of this nature will feed the casting amply if placed at an angle of 180 degrees from the flowoff. If the two are placed in direct line, there may be a small shrinkage under the flowoff. The application of a gate of this nature will require some experimental work to locate it in the correct position.

Using a gate of the above type calls for a more expensive and complicated mold than if a gate in the body core is used. A gate of this kind must answer the same purposes which have been outlined previously, and necessarily the core will be more complicated, and a little more expensive to make. The action of a gate in the core is more severe on the mold as there is some erosion and impingement of metal at the point of entry of the metal. The location of a gate of this type depends upon the type of casting made.

Metal entering the mold through the core at the bottom of the casting tends to cause shot in spite of care taken to prevent it. If the point of entry is in a thin section of the casting, erosion is hard on the mold and local heating will be severe. If the entry is in a heavy section, there will be some difficulty in feeding the gate sufficiently to prevent a spongy condition. Placing the gate at the top of the casting in such a position that the direction of the entering metal is changed abruptly as shown in Fig. 4, will reduce splashing to a minimum and the point of entry can be at a thin section that assists in the proper freezing of the gate.

A gate in such a position should be wide and thin so the metal will fall in the mold in a flat wide stream which extends the area of impingement and reduces the ill effects of this action. Metal should not enter the mold at a spot where it strikes any lettering or sharp corners, as these are the weakest points in the mold face and most susceptible to cracking and erosion.

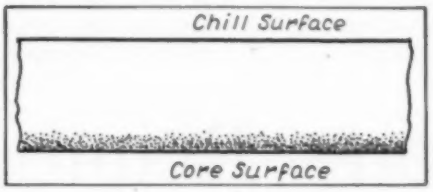


FIG. 6—SLOWER COOLING FROM THE CORE SURFACE PERMITS SOME GRAPHITE PRECIPITATION

As previously stated cupola malleable was the material cast in the permanent molds described. Sections 1¾ inches thick have been poured with metal normally intended for ¼-inch sections in sand, and the effect of the chill mold has turned this metal completely white. The heavy sections made in this manner have shown the same strength as the lighter sections made in sand. With metal of a composition giving a quite spotted or nearly black fracture in a test bar in sand, the cooling action of the mold will be sufficient to make the outer 75 per cent of the casting white with a few black spots next to the core, as shown in Fig. 6.

In cupola malleable practice, it is hard to prevent such a condition occurring from time to time, but, while all castings made of this metal in sand will be scrapped, those made on chill molds will pass. Air furnace or open hearth iron does not have this objectionable feature that is apt to occur in cupola metal and so there is less reason for chill molds in foundries dependent upon these sources for their metal supply. However, if small work in sand is being poured from air furnace or open hearth iron, the chill mold will serve a definite purpose in the production of larger work from the same metal.

Metals for chill mold castings should be poured as cold as possible to care for the shrinkage characteristics of the white iron, and to conserve the life of the mold. Pouring temperatures are controlled by the metal composition and the thickness of the casting. The higher the carbon and silicon and the heavier the section of the casting, the colder the metal is poured. Investigation showed that 2400 to 2500 degrees Fahr. as determined by an optical pyrometer, was the range most suitable.

The exact temperature for each casting was determined by experiment and increased or decreased according to the metal composition and its action in the molds. This point calls for considerable judgment on the part of the operator. It is desirable to have as wide a range of pouring temperature as possible, but the results obtained indicate that satisfactory production lies within rather narrow limits.

Metal poured too cold will show wrinkles at the bottom of the casting as it lies in the mold. This is caused by the rapid freezing of the metal and its resultant sluggishness. Cold runs and cold laps are frequent with metal a little too low in temperature. Metal that has been oxidized slightly also will give a great deal of trouble from these flaws. On the other hand, iron that is too hot, while it gives an excellent surface to the piece, causes the work to be scrapped because of shrinkage, porous spots, and small holes that are found on later treatment of the casting. A pouring temperature will be found that will give a casting free from wrinkles, seams and cold runs, and still be sound in all later inspections.

Increase Freezing Rate

Metal should be poured into the mold at a rate and temperature that permits the casting to solidify as soon as the mold is full. It is well recognized that this is a difficult point to reach but it gives the fine results that can be obtained from the use of chill molds. The colder the metal can be poured, the more rapid is the rate of freezing from the mold to the core as compared to the rate from the core toward the chill. This may be as great as eight to one and the higher the ratio, the better will be the casting in point of soundness.

Close attention must be paid to the pouring technique. When cupola malleable is cooled to the pouring ranges mentioned, metalloids and oxides are thrown out of solution and collect on the surface of the metal. The slag formed is fluid and hard to restrain from following the stream of iron into

the mold. Agitation on entering the mold causes this slag to pass skim gates and it will be found next to the chill in the finished casting. Under some conditions of metal, the slag forms a gas in contact with the casting before setting of the metal is complete. In such cases, holes will be found under the slag particle. Agitation of the metal from pouring, also causes this slag to separate from apparently clean metal. This slag will be found next to the core, generally at the bottom of the casting or around the gate, and results in small gas holes appearing after machining.

Any washed sand will be found next to the chill surface. This condition is harder to control in castings gated through the core than those which are gated otherwise. Shot formed from splashing metal as it first enters the mold will be carried to the top of the mold and will leave a rough, bubble-like appearance. Any gas that is trapped in the mold will be caught at unvented pockets or at the top of the mold. In either case it prevents the mold from filling completely. Blows from the core will be found after the casting has been cleaned and are characterized by a thin layer of metal at the top of the casting which covers a large smooth cavity. Occluded gas is retained till solidification, and its effect will show at the point where chilling action of the mold and core meet. This defect is another that does not show till the casting is machined.

The use of semipermanent molds is particularly advantageous where cupola malleable is used. It is of more benefit in making castings of medium and heavy section than in light work. The method has many difficulties and requires close attention to all points for its successful operation. In some ways use of metal molds appears different from sand cast work but analysis will show that the same principles apply. More care must be taken in the application of good foundry principles in chill molding than is required in sand practice.

Use of this method widens the scope of the malleable foundry whose main production at present is small castings. Production of heavier castings can be obtained with a minimum of metal mixtures. It also allows the manufacture of large castings during the day, in plants where it has been the custom to hold this work till the last of the heat and pour with a special mixture.

Much remains to be done in this field of chill molds. The way is clear for the development in mold, cores and operating equipment to reduce costs and eliminate the present difficulties. These problems are indicated and it is hoped that they will be solved in a short time. The main points of the method have been worked out and the application of chill molds to malleable iron production can be made a commercial and economic success.

Cast Iron Cores Reinforce Columns

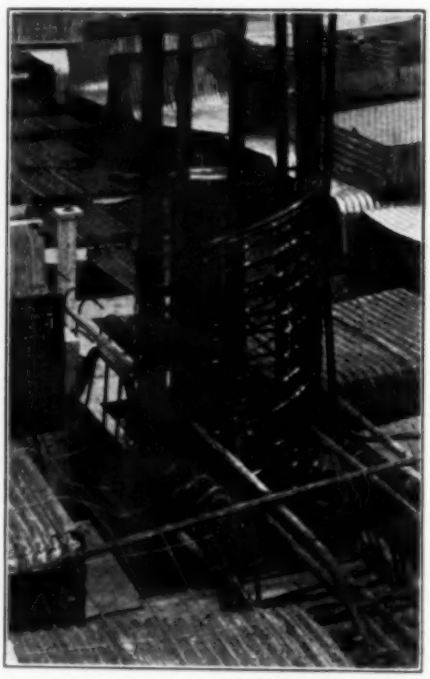
of Concrete Building

AN INTERESTING use of cast iron is found in the new 16-story McGraw-Hill building at Chicago. Structural features in this new building include composite concrete columns with solid cast-iron cores, according to an article published in *Engineering News-Record*. To conserve space the designer adopted a composite column known as the Emperger type, in which the use of a cast-iron core permits a relatively small column cross section. The core is supplemented by bars and spirals.

Columns are uniformly 24 x 24 inches or 26 x 26 inches in sections except those in the elevator group which are 20 x 36 inches. The sizes are continued from foundation to roof, the gradual deduction in required strength being made by reducing the core diameter and the amount of reinforcing steel. This uniformity of column section resulted in a material reduction in the cost of frame work.

The cast-iron cores are solid cylinders in one-story lengths, having the ends chipped and roughly tooled and then milled so as to be truly square with the axis. In the lower floors the cores are 11 inches in diameter, the size then reducing gradually to 3 inches for the top story. Cast-iron stubs or short columns enlarged at the bottom to form flat bases or shoes are embeded in the concrete footing while the tops project to form seats for the first tier of cores. Dowel rods also project from the footing to receive the ends of the vertical bars.

Each core extends 5 inches above the finished floor level. For the joint, a pipe sleeve is placed over the core, seated on the frame work and centered by four ¼-inch wires hooked over the top and inclined so that the lower ends bear against the face of the core. This sleeve is 10 inches long and from 1 to 2 inches greater in diameter than the core, the annular space being filled with cement grout to within 1 inch of the top of the core. When the column form and reinforcing steel for the next story had been placed, the sleeve was filled with grout and the next core was lowered into the form and carefully adjusted in the sleeve, all cement between the cores, except a thin film, being squeezed out. The core was then plumbed and secured in position by tie wires after which the concrete for the column was poured special care being taken to prevent any displacement of the cores. Forms generally were left in place for 14 days. The top of a column form with the core and reinforcement is shown in the accompanying illustration.



CAST IRON CORE IN COMPOSITE CONCRETE COLUMNS PERMITS USE OF SMALL COLUMN CROSS-SECTIONS

The cores were specified to be of tough gray iron, such that 1-inch test bars 14 inches long with a concentrated load at the center of a 12-inch span would not fail under less than 2240 pounds, corresponding to a bending stress of 40,000 pounds per square inch.

What Others Are Thinking

Abstracts Selected from the World's Foundry Literature

Uses X-rays in the Foundry

Roentgenologische Erkennungsmoeglichkeiten von Gusserzeugungsfehlern in Giessereibetrieben (Possibilities of X-ray Recognition of Casting Production Failures in Foundry Operations), by H. Reininger, *Die Giesserei*, Jan. 10 and 17, 1930.

This article discusses the application of the X-ray and fluoroscope as a means to determine possible causes for defective castings previous to pouring the molds. In the first part of the article the author presents a number of illustrations or shadowgraphs of cores to show the application of X-rays to determine that the vent is located properly and not obstructed. In the second part he extends the application to examination of closed molds and shows examples of improperly placed cores, chaplets, rammed in chill plate, etc.

Gives Properties of Permanent Molds

La Fabrication des Coquilles Pour le Moulage de l'Aluminium et de ses Alliages, (The Manufacture of Chill Molds for the Casting of Aluminum and Its Alloys) by H. Poulain. *La Revue de Fonderie Moderne*, Paris, Dec. 25, 1929.

This article is a reprint from the French *Revue de l'Aluminium*. It is pointed out that the cost of the mold is not the only question to be taken into consideration in the purchase of a permanent mold as it often is preferable to pay a high price to have a well constructed mold. Permanent molds only should be used for castings of moderate or small weight which can be manufactured in large quantities. A mold should produce 50,000 castings or more.

The manufacturer of the mold may not be familiar with the requirements of the user from the standpoint of foundry practice. A mold should be absolutely precise in its shape and dimensions; should limit the quantity of metal required for heads, risers, etc., to the minimum; should enable the utilization of production methods; should have lasting qualities; should be designed to cast at least 50,000 castings, and should be such that it can be used with any aluminum alloy. It is recalled that the alloys used for permanent mold castings have a low density, considerable contraction, and are fragile when hot. These various points are developed in the body of the article.

Permanent molds generally are made of gray cast iron containing a small percentage of phosphorus, presenting a fine structure, and easy to machine. An analysis of that metal is given as follows: Graphite, 2.90 per cent; combined carbon, 0.40 per cent; silicon, 1.50 per cent; phosphorus, 0.50 per cent; sulphur, 0.05 per cent; manganese, 0.90 per cent. In view of the comparatively small tonnage of cast iron used for the permanent mold construction, it does not seem worth while to prepare a cast iron of special composition. The article then gives a number of points on mold design, the composition and size of gates and risers, mounting of gates, section thickness of molds, cores, mold closing mechanisms and machining operations.

Lead Should Not Be Present

The Effect of Lead on Manganese Bronze, by James Silberstein, *The Metal Industry*, London, Dec. 27, 1929.

The author explains the use of manganese bronze castings in the electrical industry and tells the effect of certain impurities on the conductivity of that alloy. In the production of manganese bronze rings for electric motors, he was confronted with a bad case of cracking. He gives the alloy used and explains the many steps that were taken to remedy the situation. It was determined that a small quantity of lead was responsible for the defect. The remainder of the article explains the effect of lead on manganese bronzes. The author states that an extremely small percentage of lead goes into solid solution, according to some authorities not more than 0.10 per cent.

Describes Sand Testing Method

Nouvelles Methodes d'Essai des Sables (New Testing Methods for Sands), by F. Gramme, engineer-chemist at the Paris works of Babcock & Wilcox. *Bulletin*, Association Technique de Fonderie de Belgique, Brussels, January, 1930.

In determining the amount of moisture in sand, this method takes advantage of the fact that water and xylene do not mix. The sand is boiled with a certain quantity of xylene, and the vapors produced are condensed. The xylene and the water are separated, and the quantity of water evaporated during a given time is measured. The boiling point is at 91 degrees Cent. The test can be made in 15 minutes and is quicker than the usual method of oven drying.

A physical analysis of the sand is made after the test for measuring the humidity, by adding a solution of calcium chloride followed by a portion of white spirit to the sand. Silicious matter, clay and colloids separate on standing and it is possible to measure the proportion of each. It also is possible to obtain the approximate weight of each of the constituents by syphoning and drying them. The colloids are concentrated in the white spirit, the clay in the solution of calcium chloride, and the silicious matter concentrating at the container's bottom.

Gives Uses for Electric Furnaces

Les Tendances Actuelles dans la Construction et l'Emploi des Fours Electriques de Fonderie (Present Tendencies in the Construction and Use of Electric Furnaces in the Foundry), by Albert Levasseur. *Bulletin*, Association Technique de Fonderie, Paris, December, 1929.

The first part deals with the choice of the type of furnace. The low-frequency induction furnace generally is used in a steel foundry for making high-grade hard steels such as usually are obtained in the crucible. The arc furnace is the normal one for the steel foundry. However, if a high temperature is to be reached in an atmosphere free from carbon, the high frequency induction furnace should be used. Although its original cost is high, its operating cost is shown to be materially less than that of a crucible furnace.

The arc furnace is used in the gray iron foundry, often in conjunction with the cupola. In nonferrous foundries, several factors are to be considered. These include the nature of the alloy with respect to its temperature of fusion, its zinc content and its conductivity; the consumption of energy of the various types of furnaces, the low-frequency induction furnace being more economical in this respect; other considerations, such as continuous or noncontinuous production. A description of the Russ furnace is given. It is stated that larger electric furnaces are more economical than the smaller ones, both from the standpoint of capital expenditure and operation costs. Some suggestions are made concerning furnaces for heat-treatment and enameling.

Explains Effect of Nickel

Nickel in the Iron Foundry, by Arthur B. Everest, *Foundry Trade Journal*, London, Jan. 2, 1930.

In this article the author explains the effect of nickel on cast iron of various sections and tells how it may be added to the metal to improve the machining properties. He comments on the fact that nickel reduces porosity and increases the density of heavy sections without impairing the machining properties.

The effect of nickel and silicon are explained and the procedure outlined by which the best results may be obtained by additions of the former element. This is brought out with the use of diagrams showing the effects of silicon and nickel on chill and hardness, hardness variations and equalization of structure.

The author shows the effect of nickel in the foundry by the use of illustrations of several types of castings in which that element was and was not used. He comments on its effect on the foundry properties of iron and gives percentages used.

DAN M. AVEY
Editor

The Shakeout

FRANK G. STEINEBACH
Managing Editor

PAT DWYER
Engineering Editor

EDWIN BREMER
Metallurgical Editor

CHARLES VICKERS
Nonferrous Editor

NORMAN F. HINDLE
Assistant Editor

¶ Co-operating with Educators

INCREASE in the yearly production of malleable, steel and gray iron castings is apparent after a study of available statistics. Reports from the department of commerce for malleable and steel casting production indicate not only a maintenance of past position, but an increase in keeping with general industrial development. Based entirely on the production of foundry pig iron and not taking into consideration the large quantities of steel and iron scrap melted in the cupola, the highest production of gray iron castings in the history of the industry is shown for 1929.

The steady growth in the output of castings has not resulted from an increase in the number of foundries, but rather development of production methods in many existing establishments. Mechanical equipment supplants hand methods and has brought about closer control of foundry operations. The laboratory has become an essential part of the modern foundry.

CHANGES in the operation of foundries have created a need for technically trained men. The technical graduate, familiar with the fundamentals of foundry practice, is becoming a more important cog in the operation of the mechanized plant. However, it seems difficult to obtain men having these qualifications. Lack of knowledge of foundry operations or an aversion to foundry work resulting from a failure to grasp the importance of opportunities presented by the industry, have made it difficult to secure men of the proper type. For this reason, it is highly desirable that the technical student should realize the place occupied by castings in the progress of this mechanical age and that he be taught the fundamentals of foundry practice.

However, lack of knowledge on problems relating to foundry practice is not confined to the young man who becomes connected with a foundry following graduation. Men of the industry, as shown in an article on page 80 of this issue, are agreed that it is highly important that all engineers be familiar with foundry practices. The relationship of castings to engineering or the place of the foundry in the industrial scheme must be understood thoroughly if the engineer is to give due recognition to castings as engineering materials, to appreciate the problems of foundry practice and to understand the romance of the foundry industry.

ENGINEERING universities, high schools, trade schools and apprentice training systems, all must be utilized in the educational training of future workers in the foundry industry. Progress in any of these branches will result only from complete co-operation on the part of foundrymen. Industrial leaders must investigate existing conditions. They must create sufficient interest in the subject that funds will become available to provide the necessary equipment for the proper administration of the course in foundry practice. They must co-operate with the teaching staff to develop a course of study that will permit the student to place the foundry industry in its rightful place in the industrial picture. If proper co-operation is developed, foundrymen will not find it difficult to interest technical men in foundry work and engineering graduates will know far more of the valuable properties of castings than they do at present.

¶ Keep the Shop Clean

MANAGEMENT often finds it exceedingly difficult to keep the nooks and corners of the foundry free from dirt and rubbish. Numerous plans have been evolved to correct this troublesome situation with varying degrees of success. Recently, in a group where this problem was presented for discussion, several foundrymen outlined the plans they have adopted to solve this problem.

IN ONE shop, a man collects all dirt and rubbish throughout the foundry and is paid a set rate for each wheelbarrow load hauled to the dump. In a second plant a fireman guards the property against fire hazards. He is given authority to order the cleanup of all materials, whether inflammable or not. Still another company employed psychology in placing the problem before the superintendents, foremen and molders. These men were asked if they would care to have their sons work in a place where dirt was allowed to accumulate. If not, why tolerate filthy conditions where other men's sons must work? Any method which will produce a clean shop is worthy of consideration.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

P. R. SCHILLING, formerly in charge of the malleable foundry for Pratt & Letchworth Co., Buffalo, has been appointed assistant superintendent, malleable iron foundry, General Electric Co., Erie, Pa. Mr. Schilling was graduated from Rensselaer Polytechnic institute, Troy, N. Y., in 1921 with a degree in electrical engineering. Following his graduation, he became associated with the United Traction Co. Mr. Schilling had spent his vacations working for the Troy Malleable Iron Works, Troy, N. Y. He became interested in that line of endeavor and in 1922 became connected with the American Malleable Castings association, now the Malleable Iron Research institute, as inspector. He left that position to become assistant to the general manager of the Superior Steel & Malleable Castings Co., Benton Harbor, Mich. Later he was appointed superintendent of the malleable foundry of that company. In November, 1928, he accepted a position as superintendent with the Wagner Malleable Iron Co., Decatur, Ill., and placed in operation the Kalamazoo Malleable Iron Foundry, Kalamazoo, Mich., which had been acquired by that company. He resigned that position to take charge of the malleable iron foundry for the Pratt & Letchworth Co., Buffalo.

C. M. Dale has been appointed foundry manager of the Liberty Foundries Co., Rockford, Ill., following the death of E. C. Landgraf.

Walter J. Elberth, formerly foundry supervisor at the Allis Chalmers Mfg. Co., West Allis, Wis., has been appointed foundry superintendent for the Newton Foundry Co., Newton, Iowa.

A. L. Boegehold, director, metallurgical division, General Motors Research Laboratories, Detroit, addressed the regular monthly meeting of the Detroit Foundrymen's association held Feb. 20, at the Masonic temple, Detroit. Mr. Boegehold spoke on the influence of the quality of pig iron on the quality of cast iron.

King Hathaway, for several years associated with foundry organization work on the Pacific coast, has returned to the United States after a trip around the world. Mr. Hathaway formerly was connected with the Industrial Association of San Francisco. He resigned that position to reorganize and manage the Schlage Lock Co., San Francisco. Two years later he went to Japan where he lectured on management problems in some of the principal cities. He also visited a number of manufacturing plants and discussed management problems with their executives. He left Japan after several months and went to Paris where he attended the International Management congress. He stayed in Paris for several months returning to the United States to accept a position with Manning, Maxwell & Moore Inc., New York.

Form Ingot Metal Code

More than 30 members of the Nonferrous Ingot Metal institute attended a trade practice conference at Washington, during the week of Jan. 27, under the auspices of the federal trade commission at the United States chamber of commerce. A set of 27 resolutions were adopted as rules to govern the trade.

Members of the institute had met prior to the conference and ironed out differences as to the wording of the resolutions. About 80 per cent of the country's brass and bronze tonnage was represented.

Membership Increases

The Gray Iron institute, Terminal Tower building, Cleveland, has admitted the following companies to membership: James Yocom & Son Inc., 145 North Second street, Philadelphia; Crouse-Hinds Co., Syracuse, N. Y.; Fay Foundry Corp., 139 Lakeside avenue, Syracuse, N. Y.; Donlan Foundry Co., 96 Emerald street, Gardner, Mass.; Huntington Stove & Foundry Co., Huntington, W. Va., and the Marietta Mfg. Co., Point Pleasant, W. Va.

Frank B. Wetherill, formerly manager of the Link-Belt Co. office and warehouse at Portland, Oreg., has been placed in charge of the new offices and warehouse that the company has established at the Standard building, 510 West Hastings street, Vancouver, B. C. The new office will supplement the service which is being rendered by the distributors of Link-Belt products in the territory.

Organize Refractory Brick Company

Mexico Refractories Co., Mexico, Mo., has been organized for the production of refractory brick. J. B. Arthur is president of the company. The plants of the company will be constructed about a mile southwest of the city where large deposits of high quality fire clay have been discovered.

Foundry Names Officers

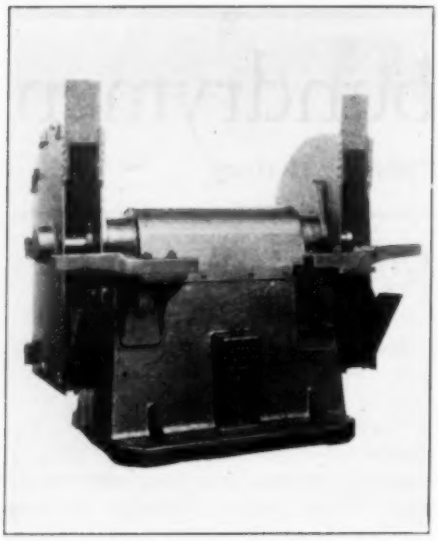
Sivyer Steel Casting Co., Milwaukee, recently combined with the Nugent Steel Castings Co., Chicago, named the following officers at a recent meeting of the stockholders: C. R. Messinger, chairman of the board of directors; L. S. Peregoy, president; M. A. Fladoes, vice president in charge of sales; George L. Pollock, secretary and C. A. MacDonald, treasurer. The directors include C. R. Messinger, W. C. Frye, Walter Kasten, Donald Fraser, C. F. Messinger, E. L. Wood, L. S. Peregoy, C. A. MacDonald, M. A. Fladoes and C. E. Stone.

Publishes Catalog

The International Molding Machine Co., 2608-2624 West Sixteenth street, Chicago, has issued a catalog of the molding machines that it manufactures. Each page contains an illustration of the machine discussed and tells the type, method of operation and the sizes in which it is made. One page has several illustrations showing typical installations. The last page is devoted to an index.

Appointed to Fellowship

H. E. Foote, who received his doctor of philosophy degree from Brown university in 1917, has been appointed to the fellowship established at the Mellon Institute of Industrial Research, Pittsburgh, by Gas Industries Inc., Pittsburgh, manufacturers of liquid-air oxygen apparatus. The investigation will be devoted to a study of the extension of the present uses of oxygen with particular reference to its application to industrial processes. Dr. Foote has been a member of the investigational staff of the institute since the year 1927.



WHEELS HAVE A SPEED OF 9500 SURFACE SPEED PER MINUTE

Designs New Grinders

Ransom Mfg. Co., Oshkosh, Wis., recently has placed on the market two new types of grinding machines. The first is equipped to handle 24 x 4-inch wheels with 2½-inch bore. The flanges are 8 inches in diameter. The machine is powered with a 7½-horsepower multispeed, ball-bearing motor, made by the Louis Allis Co., Milwaukee. The machine has push button control and is equipped with undervoltage protection and thermal, time, overload relays.

The grinder has a three-button switch with padlocks which is used to regulate the speed of the wheels. The company also furnishes a controller device with the machine that can be attached below the wheel. This controller arm automatically operates a selective switch which regulates the speed of the motor according to the diameter of the wheel. This device precludes the possibility of overspeeding. The controller will be supplied at an added cost to the customer.

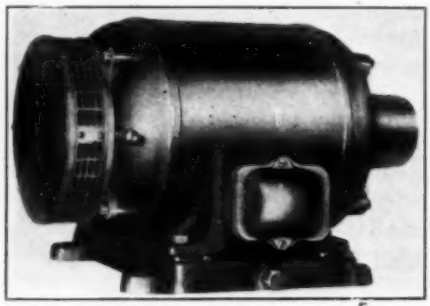
A full line of grinding machines of this type is available both for vitrified and high-speed wheels at 9500 surface feet per minute in sizes from 18 to 36 inches.

The accompanying illustration shows a machine built by the Ransom company and designed for 3 x 36-inch wheels, running at 9500 surface feet per minute. The motor is mounted in the base on a platform which is adjustable up and down by the screw shown in the front of the machine. Either 15 or 20-horsepower motors are supplied. The main spindle is driven by texropes.

The spindle is 4⅜ inches in diameter and runs on two large ball bearings. This design prevents the shaft from being sprung by bolting to foundations that do not fit the base of the machine properly. Rest brackets are adjustable. The machine weighs 5500 pounds without wheels.

Induction Motor is Air Cooled by Fan

Century Electric Co., 1806 Pine street, St. Louis, recently has introduced a line of totally, enclosed fan-cooled, squirrel-cage, induction motors, that have in most of the ratings the size advantages of a standard open-rated motor plus the added feature of full protection to the stator, rotor and other internal parts. The motor is enclosed completely with ribbed, cast-iron coil guards with no rubbing seals or air gaps. All joints are machined fits. As shown in the accompanying illustration, the fan and fan housing are mounted externally on the front end of the motor opposite the pulley end. The cooling air is drawn in at the pulley end, circulated around and over the rear coil guard, through the air passage between the field core and the frame, out over the coil guard



COOLING MECHANISM IS EQUIPPED WITH RADIAL TYPE FAN BLADES

on the front end and discharged into the air through the fan and fan housing.

Air passages are unobstructed and permit free passage of the cooling air. They do not clog easily and may be blown out with compressed air if necessary. Fan blades are radial, making the motor cooling system equally effective regardless of direction of rotation. Provisions are made to circulate the air within the motor.

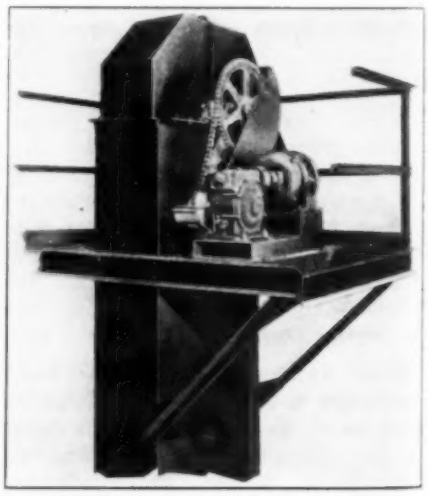
Improves Crane Control

General Electric Co., Schenectady, N. Y., recently has redesigned its line of magnetic control panels for cranes. Two types are involved, one is for use on crane bridge and trolley motions and the other is for use on hoist motions. Each type of control is available in two forms one with and the other without overload protection. On both of these types, the overload contactor which formerly opened only on overload, has been replaced by a line contactor. This is placed in the opposite side of the line to the reversing contactors and opens each time the master switch is returned to the off position. This allows complete isolation of the motor and starting resistor from the sources of power when the master switch is moved to the off position.

A new type three-point, cam-operated master switch is used with the new control. New overload relays also are incorporated which allow a greater calibration range and permit the use of only one coil instead of two or three for a given contactor size. The new control is available with or without shunts.

Elevator Is Driven by Reducer and Chain

H. W. Caldwell & Son Co., 2410 West Eighteenth street, Chicago, has placed a new standardized elevator drive on the market. The elevator is built to operate centrifugal discharge, perfect discharge or continuous bucket elevators requiring 3 to 15 horsepower. The entire line is standardized and carried in stock. The arrangement of the drive unit is shown in the accompanying illustration. The first reduction from the motor is a fully enclosed worm gear speed reducer to which the motor is connected through a flexible coupling. The motor and reducer are aligned accurately on a welded steel base and supported on a small platform of structural members attached to the elevator casing near the top. The second reduction in speed is through a roller chain and sprockets, also providing a flexible connection between the reducer and headshaft. An extra sprocket may be attached to an



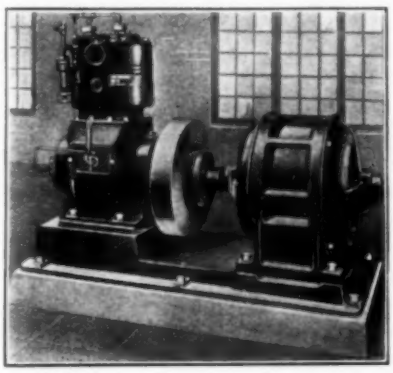
DRIVES ARE FOR CONTINUOUS ELEVATORS REQUIRING 3 TO 15 HORSEPOWER

idler frame, and in turn be adjusted to compensate for changing the height of the elevator headshaft without cutting the roller chain.

Makes Vertical, Duplex Compressor Unit

Chicago Pneumatic Tool Co., 6 East Forty-fourth street, New York, recently introduced a new type vertical, duplex, single-acting compressor to supplement its line of horizontal double-acting compressors of larger capacity. The new unit consists of a compressor and gasoline engine mounted on a subbase, as shown in the accompanying illustration. The engine drives the compressor through a detachable coupling.

The crank case of the compressor is



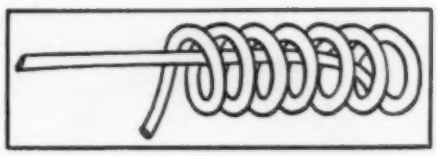
THE MACHINE IS ASSEMBLED ON A SUBBASE

completely enclosed and contains two splash troughs in which the connecting rods dip. Main bearing housings are bolted into bored openings in the crank case and are fitted with split, cast, removable, babbitt shells assembled with shims between halves. The cylinder is a one-piece casting completely water jacketed. The barrels are finished highly. The cylinder head also is a one-piece casting and is separate from the cylinder. It is water jacketed. A gasket seals the joint between the cylinder and the head.

Valves are of the flat disk type. Pistons are of cast iron and are fitted with one oil ring. The machine is equipped with automatic lubricating and air regulating systems. The compressor also is equipped wth automatc stop and start control.

Introduces Coil Chill

J. S. McCormick Co., Pittsburgh, has placed on the market a new type chill that resembles a coil spring. It is made to take the place of chills and nails. The coil consists of a spiral of soft wire to give a large chill area and at the same time fuse



CHILL RESEMBLES COIL SPRING

readily. These chills are made in various size diameters and lengths for different diameters of wire. It is claimed that this type chill makes possible the reduction of the size of risers necessary on certain type castings, in some cases as much as 50 per cent. The coils are shown in the accompanying illustration and are made of any gage wire from No. 14 to 4 and any diameter coil and length. The chills are also made of aluminum and copper coated wire.

Designs New Grinder for Metal Pattern Work

Madison-Kipp Corp., Madison, Wis., recently introduced a new type air driven grinder for metal patternmaking, diemaking and similar work. The tool is small being 8¼ inches in length, barrel diameter slightly under an inch and the weight, 12 ounces. It is operated by compressed air at shop pressures.

A turbine wheel is mounted on a spindle in the housing at the upper end of the grinder. Compressed air, supplied by a special porting arrangement, provides a spindle speed of 40,000 revolutions per minute. The upper bearing is of the grease-seal ball type and the lower a special bronze. Both are provided with lubrication devices.

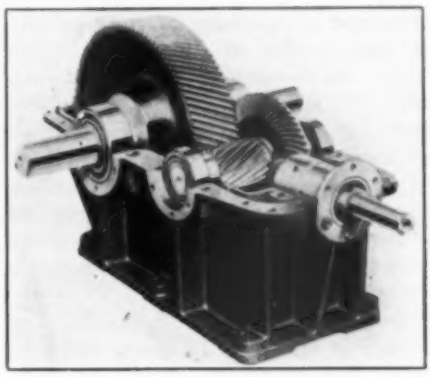
THE GRINDER HAS A SPEED OF 40,000 REVOLUTIONS PER MINUTE

The exhaust air acts as a coolant for the bearings.

The accompanying illustration gives an idea of the size of the tool. The grinder may be used for blending radii and for profiling work in irregular cavities. It also may be used to bring parts to shape and size after hardening. A variety of small grinding wheels are available and the outfit as prepared for shipment consists of hose, air connections and four grinding wheels.

Speed Reducers Are Made in Many Ratios

Falk Corp., Milwaukee, has introduced a line of right-angle drive speed reducers to supplement its line of parallel shaft drives. The new series



RIGHT ANGLE SPEED REDUCER WITH COVER REMOVED

includes both horizontal and vertical shafts. A feature of the new mechanism is a combination of single helical and spiral bevel gears. It is claimed that single helical gears for the final reduction are easier to assemble than herringbone gears and that their efficiency is practically the same. The reducer runs cool and has an initial efficiency of over 95 per cent. Another feature is the reversible construction of gears and shafts. If the gears become worn after years of service, shafts can be turned end for end to permit using the opposite and unworn sides of the teeth. That feature materially increases the life of an installation.

Ratings on the new line range from 1/16 horsepower at 100 revolutions per minute on the smallest unit to 565 horsepower at 100 revolutions per minute on the largest. Ratios are from 15 to 1 to 518 to 1. The lubricating system is simple and self-contained. A continuous splash system keeps a film of oil on the working faces of gear teeth. The accompanying illustration shows the gearing arrangement of one of the reducers with the cover removed.

Obituary

By Gus Burns

H. D. Hammond, vice president in charge of miscellaneous sales since April, 1929, for the American Steel Foundries, Chicago, died in Chicago March 1. Mr. Hammond was well known throughout the steel foundry industry. During his early training he spent four years in the offices of Robert Wetherill & Co., Chester, Pa., and one year with the Keystone Drop Forge Co., Chester. In September, 1906, he entered the employ of the American Steel Foundries at the Thurlow, Pa., works, and in March, 1910, was transferred to the Pittsburgh sales office. Three years later he was appointed production engineer at the Indiana Harbor works and was promoted to manager of railroad miscellaneous sales at Chicago in March, 1915. In December, 1917, he became general manager of miscellaneous sales, a position he held until his election as vice president in charge of miscellaneous sales, last year.

Adelbert E. Coleman, 71 years old, manufacturer of ornamental iron and bronze, died Feb. 13 at his home in Chicago. In 1893, Mr. Coleman founded the Chicago Ornamental Iron Co. For the past 15 years the company had operated under Mr. Coleman's name. For many years he was president of the Iron League of Chicago, and had served as president of the Building Construction Employers' association during the labor troubles in the Chicago building industry when the Landis award was adopted.

Louis L. Spoenemann, treasurer of the Enterprise Foundry Co., Belleville, Ill., died recently of heart failure. He was 44 years of age. Mr. Spoenemann was born in Belleville, Ill., the son of Charles Spoenemann, founder of the Enterprise Foundry Co. He has been connected with the stove foundry industry for the past 30 years.

Winter D. Hess, 64 years old, western sales representative for Glamorgan Pipe & Foundry Co., Lynchburg, Va., and of the Builders Iron Foundry, Providence, R. I., and the Darling Valve & Mfg. Co., Williamsport, Pa., died recently of a heart attack at his home in Evanston, Ill.

Cecil R. Pilsbury, 53, assistant treasurer, General Steel Castings Corp., Granite City, Ill., died in Philadelphia, Feb. 20, following an appendicitis operation. Mr. Pilsbury, started to work for the Commonwealth Steel Co. 16 years ago as a checker, advancing to the office of treasurer, which he held until the Commonwealth company was merged with the General Steel Castings Corp. last July.

H. D. HAMMOND

Kent H. Blacklidge, 43, an official of the Globe Stove & Range Co., Kokomo, Ind., was killed recently in an automobile accident.

Arthur J. Hayes, 60, former resident manager of the United States Pipe & Foundry Co., Burlington, N. J., died recently in his home in Buffalo, where he had lived since ill health forced his retirement six years ago.

Faked Foundry Facts

Cold Short

Prepares Facing Sand for Bronze Tablets

According to the present trend of the industry, with most of the men merely machine hands and many of the foremen selected for their ability in any one of half a dozen lines, except a knowledge of the molder's trade, information regarding facing sand and the proper method of selection and preparation, soon will be numbered among the lost arts.

Perhaps I should qualify that statement to include only nonferrous foundries. Both ferrous groups, iron and steel, realize the necessity of using proper facing sand, but in the brass division which I have followed for the past 15 years, a man almost has to fight for facing sand. Handling a miscellaneous line of medium weight and heavy brass and bronze castings one is called upon to practice many of the tricks of the old school.

A tablet is one form of casting that invariably causes trouble unless it is faced properly. For molds that are to be skin dried the following facing sand mixture will insure a clean smooth surface on the casting: One part new sand, 2 parts old sand, ½ part French sand, ¼ part sharp sand, ¼ part flour. A shovel, a pail or a riddle may be employed as a measuring unit, depending on the amount of facing required. The surface of the mold is sprayed with molasses water and double faced. Which means that ground French sand is shaken over the face of the mold and then lightly dusted with a parting compound to prevent it from sticking to the pattern. The mold should be well vented top and bottom and dried either with a torch, a charcoal fire or by placing it for a short time in a hot oven. For a green sand mold the French sand and the sharp sand may be omitted. The facing sand is wet down with clear water and should be worked as dry as possible consistent with safety. Of course the character of the metal is reflected in the color and appearance of the face of the casting. One suitable mixture for tablets is made up of copper 95 per cent and tin 5 per cent. A second mixture equally satisfactory under certain conditions contains copper 90 pounds, zinc 5 pounds, tin 3 pounds and lead 2 pounds.

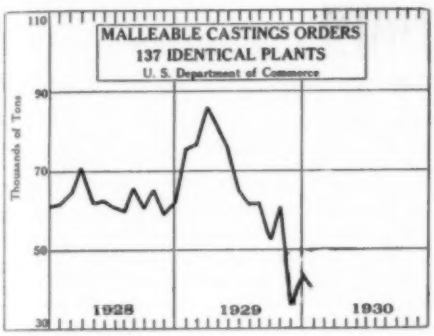
Yale & Towne Mfg. Co., Stamford, Conn., has opened a sales office at Syracuse, N. Y., at room 534 Gurney building.

Trade Trends in Tabloid

OPERATIONS are improving slightly among gray iron foundries. Production during January, according to a report of the Gray Iron institute, was 88.5 per cent of normal production, as compared with 86.2 per cent in December. Information available indicates a further gain in February.

—T—T—

The railroads purchased seventeen thousand freight cars in February, the second highest total for any month during the past four years. Reliable estimates place active freight car business at five thousand, which indicates a probable decline in purchases during March.



—T—T—

Steel foundry operations are spotty but greater activity is anticipated for April and May. January orders amounted to 97,228 tons, compared with 94,653 tons in December.

—T—T—

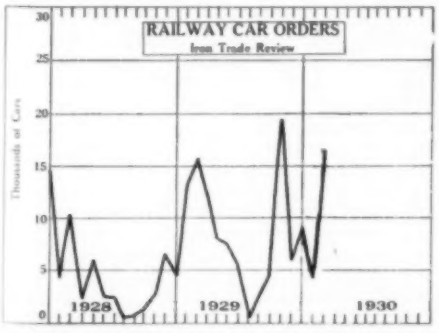
Automobile production in January totaled 282,517 units as compared with 125,913 in December. The output of several manufacturers was cut during February in an effort to keep production in line with retail buying.

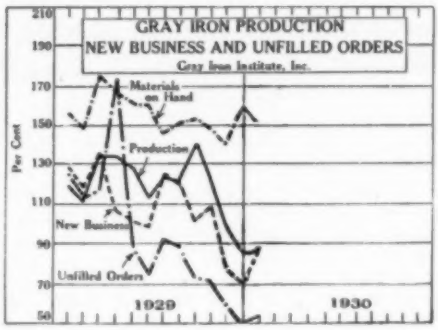
—T—T—

Inquiries for machine tools are increasing. Considerable improvement is noted in the purchases of tools by the automotive industry.

—T—T—

No letup has been noted in the purchases of farm equipment as a result





of the lower price of wheat. However, some manufacturers of equipment feel that this situation threatens the prosperity of the industry.

—T—T—

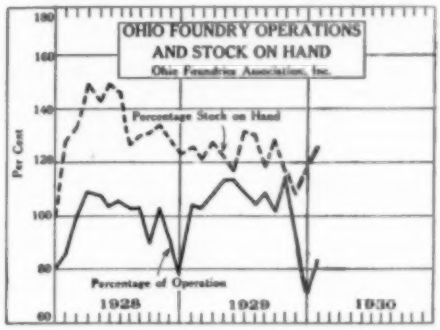
Malleable production in February was ahead of the output in January, according to preliminary reports. Prospects in this line are reasonably satisfactory, although dampened somewhat by slight drops in automotive schedules.

—T—T—

Daily production of pig iron in February gained 10.9 per cent, according to *Iron Trade Review*. Total output is given as 2,845,927 tons, while the daily average rate was 101,640 gross tons, compared with 91,573 tons in January. Merchant iron production in February registered 535,834 tons as compared with 612,406 tons in January.

RAW MATERIAL PRICES
March 6, 1930

Iron	
No. 2 foundry, Valley	$18.50
No. 2 Southern, Birmingham	15.00
No. 2 foundry, Chicago	19.50
No. 2 foundry, Philadelphia	20.76
No. 2 foundry, Buffalo	18.50
Basic, Valley	18.50
Basic, Buffalo	18.00
Malleable, Chicago	19.50
Malleable, Buffalo	19.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	9.00
Scrap	
Heavy melting steel, Valley	$16.00 to 16.50
Heavy melting steel, Pitts.	16.50 to 17.00
Heavy melting steel, Chicago	13.25 to 13.75
Stove plate, Buffalo	12.75 to 13.00
Stove plate, Chicago	11.00 to 11.50
No. 1 cast, New York	16.85
No. 1 cast, Chicago	14.00 to 14.50
No. 1 cast, Philadelphia	15.50 to 16.00
No. 1 cast, Pittsburgh	14.50 to 15.00
No. 1 cast, Birmingham	10.00 to 11.00
Car wheels, iron, Pittsburgh	14.50 to 15.00
Car wheels, iron, Chicago	14.75 to 15.25
Railroad malleable, Chicago	17.00 to 17.50
Agricultural mal., Chicago	14.75 to 15.25
Malleable, Buffalo	17.00 to 17.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	17.25 to 17.37½
Electro, copper, producers	18.00
Straits, tin	36.00
Lead, New York	5.85
Antimony, New York	8.87½
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	16.00 to 16.50
Zinc, East St. Louis, Ill.	5.00



With one or two exceptions, slight recessions are noted in steel mill operations. Heavier specifications stepped up finishing mill operations in the Chicago district during the first week of March to between 90 and 95 per cent. The rate for the entire industry was 79 per cent.

—T—T—

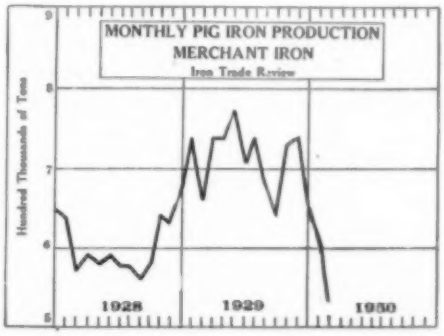
Building and engineering contracts awarded in February reached a total of $317,053,000, according to the F. W. Dodge Corp. This represents a 2 per cent loss over January, 1930. Awards for the first two months of this year amounted to $641,028,200, a loss of 17 per cent over the first two months of 1929.

—T—T—

Over-extended production facilities and large surplus stocks carried over from 1929 have clouded the immediate future of the airplane industry, according to a survey made by the Standard Statistics Co.

—T—T—

Average New York prices on nonferrous metals during January, according to *Daily Metal Trade*, follow: Casting copper, 17.078c; electrolytic copper, 18.00c; Straits tin, 38.659c; lead, 6.236c; antimony, 8.886c; aluminum, 23.90c. Zinc averaged 5.191c, East St. Louis, Ill.



What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Gorrell Carnes Foundry Co., Lima, O., was slightly damaged by fire recently.

Hershey Machine & Foundry Co., Manheim, Pa., care J. K. Nissly, plans a 1-stroy plant addition. M. H. Evans is the architect.

Ajax Foundry Co., Anniston, Ala., recently was severly damaged by fire. The loss is estimated at $25,000.

Troy Casting Co., Troy, N. Y., has been incorporated with $10,000 capital by F. C. Claessens, attorney, Burdette building.

New Art Casting Co., New York, has been incorporated with $1200 to make steel castings by the Attorney Service Co., 299 Broadway, New York.

Walker Foundry Co., Inc., Charlottesville, Va., has been incorporated with $20,000 by Charles M. Walker to engage in foundry business.

Globe American Corp., Kokomo, Ind., has been incorporated by W. D. Harvey and Darrell S. Boyd to manufacture stoves, furnaces and ranges.

Geo. W. Koehler Co., operated at 1003 North Eighth street, Cedar Rapids, Iowa, now is operated by Nathan Baldwin, one of the former proprietors, as the Baldwin Brass Foundry.

American Art Metal Works, Detroit, has been incorporated to manufacture and deal in die castings, tools and automobile hardware by John Hartman, 5032 Twenty-third street.

Emerson Brantingham Corp., Batavia, Ill., foundry operators and manufacturers of automobile parts and enamelware, is remodeling its plant and installing new machinery.

Swedish General Electric Ltd., Toronto, Ont., has been incorporated to deal in machinery castings and implements with a capital of $100,000 by George E. Atwood, 189 Rosedale Heights drive, Toronto.

Parker Street Castings Co., Henry street, Cleveland, has awarded the contract for a 1-story foundry building to the R. Hanson Construction Co., 9323 Sandusky avenue. The new addition will cost about $40,000.

Cleveland Co-operative Stove Co., Cleveland, O., has acquired the Rayglo Corp., Athens, O. Both companies specialized in the manufacture of stoves. The equipment of the Rayglo Corp. will be moved to Cleveland.

Somerville Iron Foundry Co., Washington street and Boston & Maine railroad, Somerville, Mass., Nathan P. Reed, president, soon will start work on a plant unit costing about $50,000 to be located on Mystic avenue.

Acme Pattern & Mfg. Co., 326 North Findlay street, Dayton, O., has been granted a permit for the construction of a 1-story plant addition, 75 x 115 feet, which will cost about $20,000. Hillsmith & Co. are the general contractors.

James Morrison Brass Mfg. Co., Toronto, Can., manufacturer of cast iron, steel and brass valves, has been acquired by the Equitable Securities Corp., 67 Yonge street, Toronto. Production will be increased considerable although actual future building is indefinite.

American Car & Foundry Co., Twenty-third and Third avenue, Huntington, W. Va., plans a sandblast unit addition that will cost about $50,000. John W. Ensign is district manager at Huntington. Home offices of the company are at 165 Broadway, New York.

Electric Steel Foundry Co., 1328 Second street, Berkeley, Calif., will construct a new plant addition, 100 x 122 feet. The contract for erection has been let to the Herrick Iron Works, Eighteenth and Campbell streets, Oakland, Calif. (Noted March 1.)

Midwest Brass Foundries., formerly located in Wyandotte street, Freeport, Ill., recently has moved into the foundry building formerly occupied by the Stover Mfg. & Engine Co., East Stephenson street. The company has added a general machine shop to its foundry and pattern shop.

Schill Bros. Co., Crestline, O., manufacturer of stoves and furnaces, recently was damaged by fire to the extent of $250,000. Damage was caused by the explosion of accumulated gas. Directors of the company met shortly after the accident to plan the rebuilding and repair of the plant.

Alloys Foundry Corp., Jersey City N. J., has been incorporated by the United States Corp., 150 Broadway, New York, to deal in foundry castings. The Alloys company has leased a 1-story plant at McBride avenue and Jackson lane, West Patterson, N. J., to make aluminum and copper alloy castings for the aviation and automobile industries. C. P. Brown is president.

New Trade Publications

HEATERS—General Electric Co., Schenectady, N. Y., has issued a folder describing and illustrating its sheath-wire, immersion heaters for liquid baths.

ARC WELDING—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a folder illustrating some of the uses of arc welding.

ELECTRIC HEATERS—Edwin L. Wiegand Co., 7500 Thomas boulevard, Pittsburgh, has issued a folder describing the electric strip heaters that it manufactures. The advantages, uses, specifications and prices are given. Several illustrations show the uses of these heaters.

TUMBLING MILLS—W. W. Sly Mfg. Co., Cleveland, recently has issued a folder illustrating and describing its new type tumbling mill. The advantages, details of construction, specifications and special features are described. Several illustrations show the various parts of the mill.

ELECTRIC FURNACES—Ajax Metal Co., electric furnace division, Frankford avenue below Girard avenue, Philadelphia, is circulating a folder on its electric furnaces. The folder describes the growth of the company and outlines its service to the customer. Several illustrations show various parts of the company's plant.

ENGINEERING ACHIEVEMENT—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a 36-page booklet on the engineering achievements of the company during the year 1929. The booklet covers electrical advancement in many fields and is illustrated by halftone reproductions of both operations and installations.

FLUXES—The Mathieson Alkali Works, Inc., 250 Park avenue, New York, has issued a folder describing the use of its patent flux in nonferrous metal producing shops. The advantages of the flux are explained and the proper methods of addition to open-flame, down-draft, electric arc, induction, crucible and reverberatory furnaces are explained. Its addition to ladles also is discussed.

ARC-WELDING—General Electric Co., Schenectady, N. Y., has issued a 4-page folder on its constant-potential, arc-welding set. A description of the apparatus is given and its advantages stated. Tables give the various specifications for different sized sets. One page is devoted to a description of control apparatus, and illustrations show typical installations. This company also is distributing a folder on its gas engine driven arc-welder, which describes the apparatus both in the stationary and the portable type.

PARSONS' WHITE BRASS—Cramp Brass & Iron Foundries Co., Philadelphia, has issued a folder on the uses of Parsons' white brass as a bearing metal for marine work. The folder gives information on the properties of bearing metals and shows micrographs of babbitt and white brass. Physical properties also are discussed. Directions are given for tinning bronze shells and the babbitting of bearings.

EQUIPMENT—Whiting Corp., Harvey, Ill., has issued a bulletin on casting cleaning equipment. The booklet shows the layout of a cleaning room and explains the advantages and details of construction of the various units used. The bulletin is illustrated with halftone reproductions of the equipment and photographs of typical installations. Tables show standard dimensions of tumbling mills. Details of construction and advantages of the dust filter that the company manufactures are included at the back of the catalog.

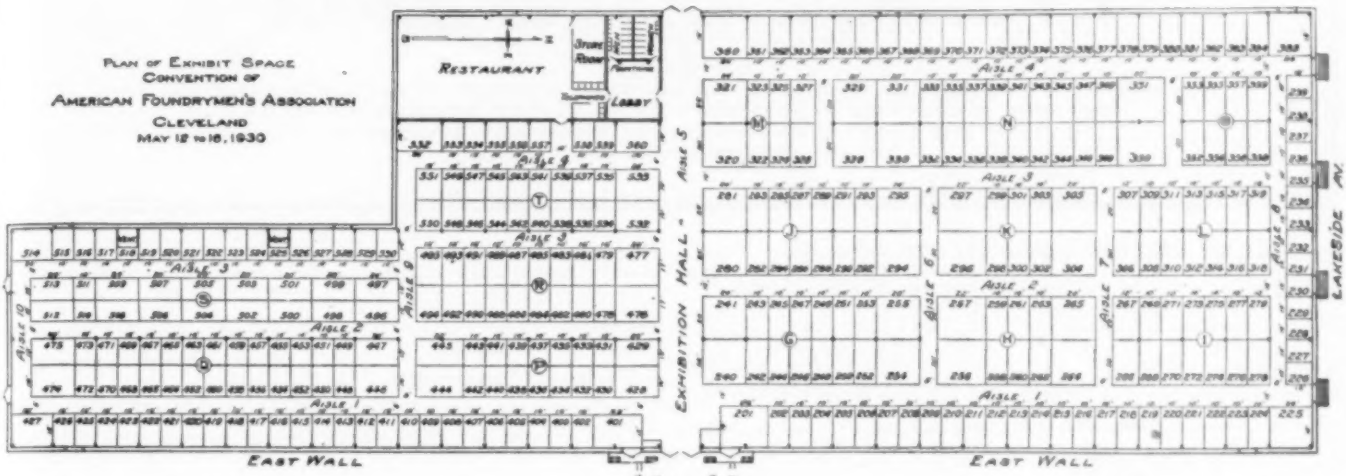
ROLLER CHAIN DRIVES—Link-Belt Co., 910 South Michigan avenue, Chicago, has issued a 46-page catalog on the roller chain drives carried in stock by the local distributors of that company. The booklet contains tables giving specifications for various drives of different horsepowers and ratios. It also carries illustrations of the types of chains made by the company and shows many typical installations. Other information on roller chain drives, standard keys, methods of installation and casings for industrial drives is given.

ROLLER BEARINGS—American Roller Bearing Co., Pittsburgh, recently published a bulletin on its roller bearings. The booklet explains the classification of bearings as made by that company, the method of manufacturing, the steel used and the methods in which the bearings are mounted. Space also is devoted to the selection and installation of bearings. A large section of the booklet is used to illustrate the various applications of roller bearings. Another section contains drawings showing various methods of industrial installation. Other information includes bearing tolerances, modification factors, specifications for different types and some physical and chemical properties of the bearings as made by the company. The American Roller Bearing Co. specializes in bearings for heavy service.

EXHIBITION

of

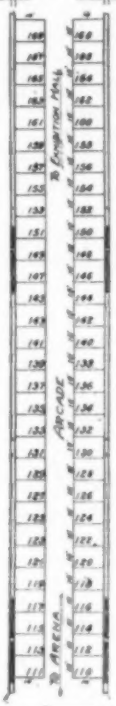
Foundry and Machine Shop Equipment and Supplies



How It Concerns You—

If you sell, buy or manufacture anything connected with equipment, machinery, supplies or services to foundries—or to machine, pattern or allied shops—you are or should be interested as a spectator, exhibitor or both.

The Exhibition is exclusively industrial, confined to persons interested either in buying or selling foundry equipment, machines or supplies. Therefore curiosity seekers and the general public are neither solicited nor admitted. Attendance is by registered card only. No "waste circulation", no "general publicity", no "luke warm" prospects. Every person present is a vitally interested, potential buyer!



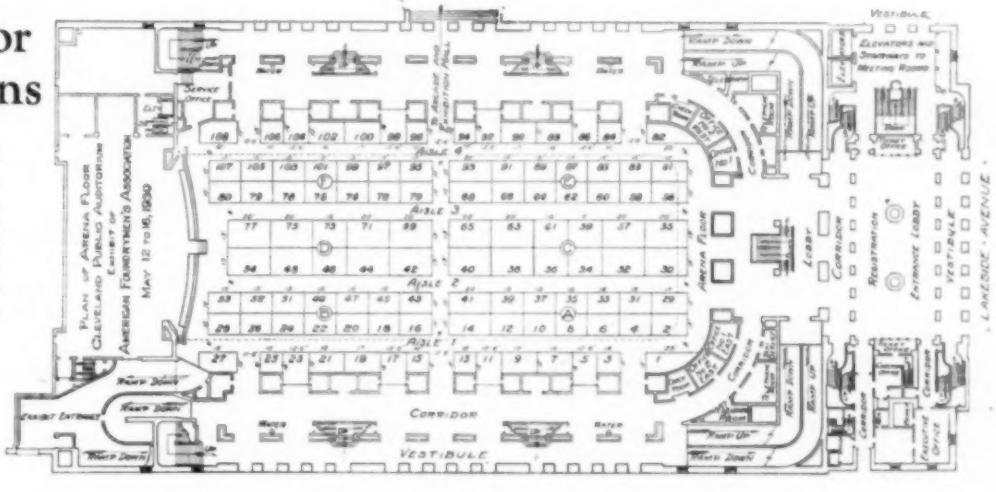
Potential Purchasing Power

Furthermore, the prospective purchasing power can be gauged by the registered attendance at the last two Exhibitions. The average was 5784. These thousands were drawn from all foundry centers of America. At the Detroit Exhibit 39 states, five Canadian provinces and several foreign countries were represented. From Ohio, where this year's Exhibit is to be held, 1020 went to Detroit. Over 83% were from points outside the Detroit district. And 90% of the registered attendance consisted of plant executives or company officers from presidents and works managers down to minor executives.

Arrange for Reservations

If you care to be among the limited number of exhibitors who will share the potential purchasing power of the registered attendance at the forthcoming Exhibition—at Cleveland this year—write or wire at once to the—

Dept. of Exhibits



American Foundrymen's Association, 222 W. Adams St., Chicago

"Where-To-Buy"

A classified-by-products list of advertisers for the convenience of readers. If you don't find what you want, write us and we will tell you where to get it. ¶Index to advertisements will give you page number of any advertiser and by referring to advertisement you can get full particulars about products.

ABRASIVE BRICKS—Rubbing
Cleveland Stone Co., 1125 Builders Exchange Bldg., Cleveland, O.
Sterling Grinding Wheel Co., Tiffin, Ohio.

ABRASIVE FILES
Cleveland Stone Co., 1125 Builders Exchange Bldg., Cleveland, O.
Sterling Grinding Wheel Co., Tiffin, Ohio.

ABRASIVE WHEELS
Cleveland Stone Co., 1125 Builders Exchange Bldg., Cleveland, O.
Safety Grinding Wheel & Machine Co., Springfield, O.
Sterling Grinding Wheel Co., Tiffin, Ohio.

ABRASIVES—Metallic Sandblast
American Steel Abrasives Co., Galion, O.
Globe Steel Abrasive Co., Dept. F., Mansfield, O.
Pangborn Corp., Hagerstown, Md.
Pittsburgh Crushed Steel Co., Pittsburgh, Pa.
Sly, W. W., Mfg. Co., 4702 Train Ave., Cleveland, O.
Steelblast Abrasives Co., Cleveland, O.
Steel Shot & Grit Co., Amesbury, Mass.

ACETYLENE DISSOLVED or in Cylinders
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York City.

ACETYLENE—Generators
Oxweld Acetylene Co., Newark, N. J.

AIR COMPRESSORS
Bury Compressor Co., 1746 Cascade St., Erie, Pa.
Curtis Pneumatic Machinery Co., 1573 Kienlen Ave., St. Louis, Mo.
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady.
Ingersoll-Rand Co., 11 Broadway, New York City.
Pennsylvania Pump & Compressor Co., Easton, Pa.

AIR CONDITIONING Equipment
Drying Systems, Inc., 1804 Foster Ave., Chicago, Ill.
Pangborn Corp., Hagerstown, Md.

AIR SEPARATORS—See Separators—Air, Moisture, Oil

AIR TOOLS—See Tools—Pneumatic

ALKALI
Mathieson Alkali Works, Inc., 250 Park Ave., New York City.

ALLOYS
Driver-Harris Co., Harrison, N. J.
Electro Metallurgical Sales Corp., 30 E. 42nd St., New York City.
Niagara Falls Smelting & Refining Corp., 2204 Elmwood St., Buffalo, N. Y.
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

ALLOYS—Aluminum
Aluminum Co. of America, 2408 Oliver Bldg., Pittsburgh, Pa.

ALLOYS—Boronic
American Boron Products Co., Inc., Ramsdell & Elmwood Ave., Buffalo, N. Y.

ALUMINUM
British Aluminium Co., 122 E. 42nd St., New York City.

ALUMINUM—Alloys and Ingots
Aluminum Co. of America, 2408 Oliver Bldg., Pittsburgh, Pa.
British Aluminum Co., 122 E. 42nd St., New York City.
Niagara Falls Smelting & Refining Corp., 2204 Elmwood St., Buffalo, N. Y.

ALUMINUM BRONZE POWDER
Aluminum Co. of America, 2408 Oliver Bldg., Pittsburgh, Pa.

ANCHORS
Paul & Beekman Manufacturing Co., 1722 N. Fifth St., Philadelphia, Pa.

ANNEALING OVENS—See Ovens—Annealing

ARC WELDING EQUIPMENT
General Electric Co., Schenectady.

ARCHITECTS—Industrial
Austin Co., The, 16112 Euclid Ave., Cleveland, O.

ARRESTORS & COLLECTORS—Dust—See Dust Arresting and Collecting Systems

BABBITT METAL
Ajax Metal Co., 46 Richmond St., Philadelphia, Pa.

BAND SAWS—See Saws—Metal Band

BANDS, SNAP FLASK—Steel
Adams Co., The, 175 Foster St., Dubuque, Iowa.

BARROWS—Foundry
Sterling Wheelbarrow Co., Milwaukee, Wis.

BARS—Aluminum
Aluminum Co. of America, 2408 Oliver Bldg., Pittsburgh, Pa.

BARS—Iron and Steel
Bethlehem Steel Co., Bethlehem, Pa.

BEARINGS—Crane
Hyatt Roller Bearing Co., Harrison, N. J.

BEARINGS—Hoist
Hyatt Roller Bearing Co., Harrison, N. J.

BEARINGS—Roller
Hyatt Roller Bearing Co., Harrison, N. J.

BEARINGS—Steel Mill—Equipment
Hyatt Roller Bearing Co., Harrison, N. J.

BEARINGS—Trolley
Hyatt Roller Bearing Co., Harrison, N. J.

BELLOWS—Molders
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Pettinos, Geo. F., 1206 Locust St., Philadelphia, Pa.

BENCHES—Molders
Western Tool & Mfg. Co., The, Springfield, Ohio.

BINDERS—See Core Binders

BLACKING MIXTURE
Pettinos, Geo. F., 1206 Locust St., Philadelphia, Pa.
Stevens, Frederic B., Inc., Larned and Third St., Detroit, Mich.

BLOCKS—Chain
Box Crane & Hoist Corp., 2226 Ontario St., Philadelphia, Pa.
Chisholm-Moore Hoist Corp., (Division of Columbus-McKinnon Chain Co.), Fremont Ave., Tonawanda, N. Y.

BLOW COCKS
Adams Co., The, 175 Foster St., Dubuque, Iowa.

BLOWERS
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady.
Ingersoll-Rand Co., 11 Broadway, New York City.
Knickerbocker Co., The, Jackson, Mich.
Spencer Turbine Co., Hartford, Conn.

BLOWPIPES—Brazing, Cutting, Welding, etc.
Oxweld Acetylene Co., Newark, N. J.

BLUE POTS—Patternshop
General Electric Co., Schenectady.

BOLTS AND NUTS
Bethlehem Steel Co., Bethlehem, Pa.
Bourne-Fuller Co., 1912 Scranton Rd., Cleveland, O.

BOND—Molding Sand
Illinois Clay Products Co., Barber Bldg., Joliet, Ill.

BOOKS—Technical
Penton Publishing Co., Cleveland.

BOTTOM PLATES—Steel
Adams Co., 175 Foster St., Dubuque, Iowa.
Shanafelt Mfg. Co., Canton, O.
Truscon Steel Co. (Pressed Steel Div.), Youngstown, O.
Wadsworth Core Machine & Equipment Co., Akron, O.

BOXES—Tote
Sterling Wheelbarrow Co., Milwaukee, Wis.

BRICK—Refractory
Corundite Refractories, Inc., 920 Duquesne Way, Pittsburgh, Pa.

BRONZE—Manganese
Ajax Metal Co., 46 Richmond St., Philadelphia, Pa.

BRUSHES
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.

BRUSHES—Motor and Generator
General Electric Co., Schenectady.
United States Graphite Co., Saginaw, Mich.

BRUSHES—Wire
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.

BUCKET CARRIERS
Chain Belt Co., 273 Park St., Milwaukee, Wis.

BUCKET LOADERS FOR Sand Mills
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.

BUCKETS
Penn Foundry & Mfg. Co., Reading, Pa.

BUCKETS—Clam Shell, Drag Line, Grab
Brosius, Edgar E., 19th St. & P. R. R., Sharpsburg P. O., Pittsburgh, Pa.
Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.
Whiting Corp., The, Harvey, Ill.
Williams, G. H., Co., 611 Harbarger Lane, Erie, Pa.

BUCKETS—Elevating
Chain Belt Co., 273 Park St., Milwaukee, Wis.

BUFFING COMPOSITIONS
Stevens, Frederic B., Inc., Larned and Third St., Detroit, Mich.

BUILDING—Foundry, Factory, Industrial
Austin Co., The, 16112 Euclid Ave., Cleveland, O.

BURNERS—Acetylene—See Torches and Burners—Acetylene, Blow, Oxy-Acetylene

BURNERS—Oil or Gas
Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O.
Hauck Manufacturing Co., 126 Tenth St., Brooklyn, N. Y.

BUSHINGS—Flask Pins
Michigan Screw Co., Lansing, Mich.

CALKING HAMMERS—Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.

CARBON BURNING Apparatus
Oxweld Acetylene Co., Newark, N. J.

CARBON RODS AND Paste for Welding
Oxweld Acetylene Co., Newark, N. J.

CARS—Annealing, Billet Furnace Charging, Core Oven, Pig iron
Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O.

CARS—Platform, Industrial Railway, Transfer, Narrow Gage
Foundry Equipment Co., The, 1831 Columbus Rd., Cleveland, O.
Northern Engineering Works, 210 Chene St., Detroit, Mich.
Penn Foundry & Mfg. Co., Reading, Pa.
Whiting Corp., The, Harvey, Ill.